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AJO PEAK TO TINAJAS ALTAS: FLORA OF SOUTHWESTERN ARIZONA PART 8. EUDICOTS: ACANTHACEAE – APOCYNACEAE

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ABSTRACT

A floristic account is provided for seven eudicot families as part of the vascular plant flora of the contiguous protected areas of Organ Pipe Cactus National Monument, Cabeza Prieta National Wildlife Refuge, and the Tinajas Altas Region in southwestern Arizona: Acanthaceae (5 genera, 7 species), Adoxaceae (1 genus, 1 species), Aizoaceae (2 genera, 3 species), Amaranthaceae (12 genera, 22 species), Anacardiaceae (1 genus, 2 species), Apiaceae (6 genera, 6 species), and Apocynaceae (5 genera, 10 species). This is the eighth contribution for this flora published in Phytoneuron and also posted open access on the website of the University of Arizona Herbarium (ARIZ).

This contribution to our flora in southwestern Arizona is the eighth published in a series in Phytoneuron and also posted open access on the website of the University of Arizona Herbarium (ARIZ; Figure 1). Seven eudicot families are included in this contribution: Acanthaceae (5 genera, 7 species), Adoxaceae (1 genus, 1 species), Aizoaceae (2 genera, 3 species), Amaranthaceae (12 genera, 22 species), Anacardiaceae (1 genus, 2 species), Apiaceae (6 genera, 6 species), and Apocynaceae (5 genera, 10 species).

The first article in this series includes maps and brief descriptions of the physical, biological, ecological, floristic, and deep history of the flora area (Felger et al. 2013a). This flora includes the modern, present-day taxa as well as fossil records from packrat middens. Explanation of the format for the flora series is provided in part 3 (Felger et al. 2013b). These contributions are also posted open access on the website of the University of Arizona Herbarium (ARIZ). Family designations follow APG III (Angiosperm Phylogeny Group 2009; also see Stevens 2001). Vernacular, or common names, when known or deemed worthwhile, are given in English, Spanish, and the Hia-Ced O'odham dialect, respectively. Fossil specimens are indicated with a dagger symbol (†) and taxa represented by fossils no longer present in the flora are marked with two dagger symbols (††). All specimens cited are at the University of Arizona Herbarium (ARIZ) unless otherwise indicated by the

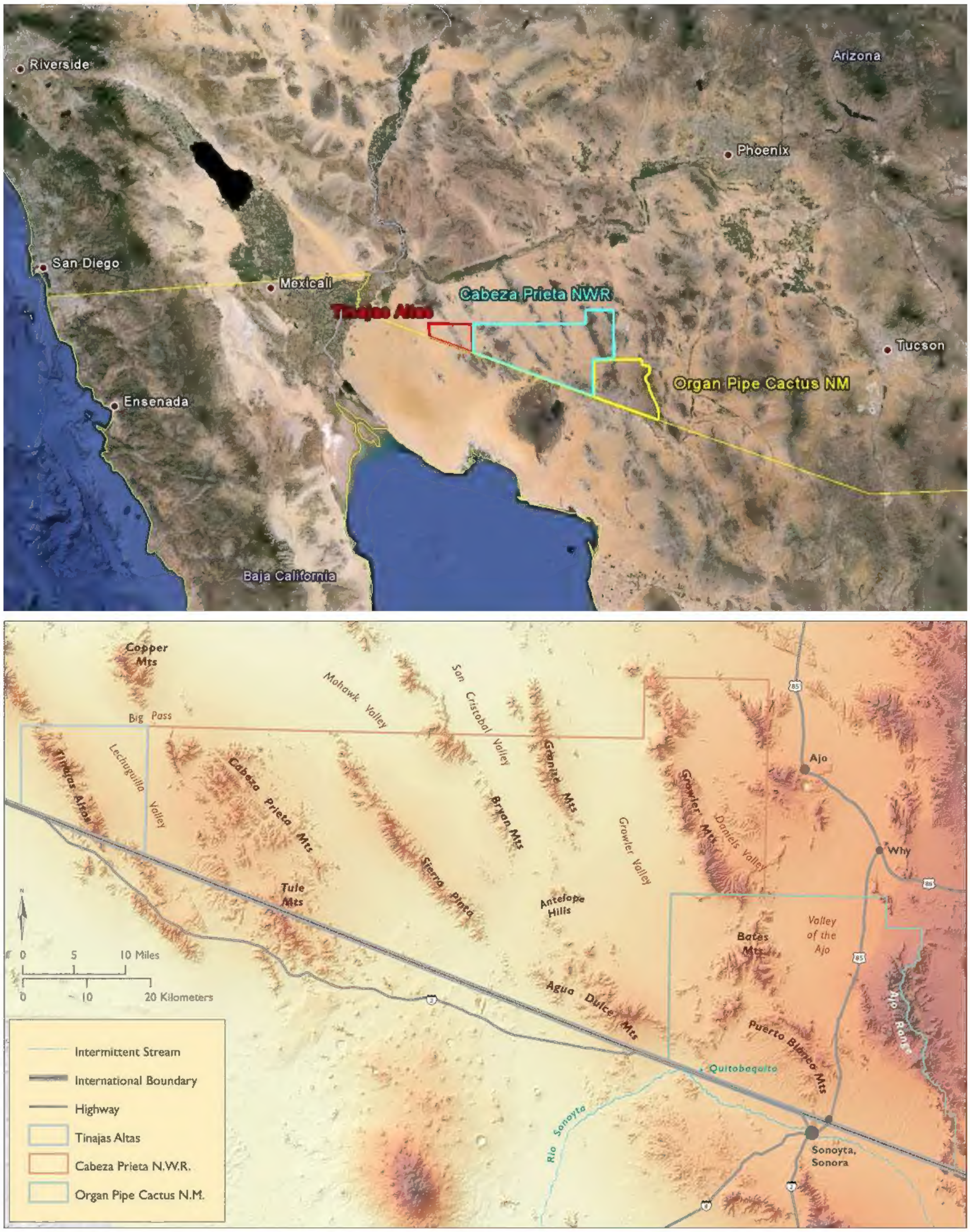

Figure 1. Flora area in southwestern Arizona. (A) Above, overview of regional context; (B) below, detail with local place names. Map B prepared by Ami Pate of Organ Pipe Cactus NM, 2013.

abbreviations for herbaria at Cabeza Prieta National Wildlife Refuge (CAB), Organ Pipe Cactus National Monument (ORPI), and the standardized abbreviations for herbaria (Index Herbariorum, Thiers 2013). All photos and scans are by Sue Rutman unless otherwise stated and all botanical illustrations are by Lucretia Brezeale Hamilton (1908–1986). Descriptions and keys pertain to taxa and populations within the flora area.

ACANTHACEAE – Acanthus Family

Herbaceous perennials and shrubs (also some trees in other regions, such as black mangrove, *Avicennia germinans*). Leaves opposite, simple, entire; stipules none. Flowers attractive, subtended by bracts; corollas bilaterally symmetrical. Stamen 2, or 4 in *Ruellia*. Fruit a capsule, elastically and explosively dehiscent with seeds borne on retinacula (distinctive hooks); seeds 4, or 10 or more in *Ruellia*.

Acanths have their greatest diversity in tropical and subtropical regions. In the flora area they are generally winter dormant or cease growing during the cooler times of year and during drought. The five genera and seven species in the flora area all occur in Organ Pipe. *Carlowrightia* and *Justicia californica* extend into Cabeza Prieta and only *J. californica* makes it to the hyperarid Tinajas Altas Region in the westernmost part of flora area. *Carlowrightia arizonica* and *Justicia californica* are the most arid-inhabiting members of the family in the Southwest and the only ones extending into California. Major factors limiting acanth distributions in the region seem to be freezing weather and the paucity of summer rains.

Hummingbirds are the usual pollinators of the red- or orange-flowered species of *Anisacanthus* and *Justicia*, generally called *chuparrosa* in Mexico. These flowers are diurnal and open all day, or the corollas may fall away with daytime heat. The pure white flowers of *J. longii* are nocturnal, and the others acanths have whitish to lavender corollas opening shortly after sunrise and falling with daytime heat.

Worldwide, mostly in tropics and subtropics, few in temperate regions; at least 220 genera and 4000 species. About 35 species occur in the Río May region of southeastern Sonora and southwestern Chihuahua (Martin et al. 1998) and the numbers diminish to the north and westward (Daniel 1984; Felger 2000).

1. Shrubs, often to 1 m or more tall; corollas red or orange.

    2. Bark shredding; stamens positioned along the lower lip of the corolla, the anthers opening toward the upper lip. ..... **Anisacanthus**
    2. Bark not shredding; stamens positioned along the upper lip of the corolla, the anthers opening toward the lower lip. ..... **Justicia californica, J. candicans**

1. Herbaceous to subshrub (suffrutescent) perennials, mostly less than 1 m tall; corollas white, cream, blue, violet, or purple.

    3. Stems 6-ridged (hexagonal in cross-section); flowers and fruits enclosed by a pair of heart-shaped to nearly triangular or kidney-shaped bracts 7–15 mm long; corollas twisted through 180°, pink to pale violet with white markings on lip. ..... **Dicliptera**
    3. Stems 4-ridged (quadrate) to rounded (terete) in cross-section; flowers and fruits not enclosed by bracts as above; corollas not twisted, white, white and lavender, or violet colored.

4. Corollas white with lavender and yellow markings on the lip; fruits narrowed at the base, abruptly flared above. ..... **Carlowrightia**
4. Flowers pure white or lavender; fruits not noticeably narrowed at the base, and not flared above.

5. Petioles to 0.7 cm long, the leaf blades 0.5–7 cm long; flowers axillary, paired and subsessile, white, and nocturnal; fertile stamens 2; seeds 4. ..... **Justicia longii**
5. Petioles to 5 cm long, the leaf blades mostly 5–15 cm long; flowers in terminal, panicle-like inflorescences, the flowers usually pedicelled, lavender, and diurnal; fertile stamens 4; seeds 10 or more. ..... **Ruellia**

Anisacanthus thurberi (Torrey) A. Gray
Desert honeysuckle. Figure 2.

Shrubs with relatively slender stems and peeling bark; generally becoming leafless during winter or extended drought. Corollas orange-red (brick orange), 4–5 cm long. Stamens 2. Capsules 1–1.5 cm long, seeds 4 or fewer. Flowering non-seasonally although usually winter dormant.

Organ Pipe except the southwestern portion; mostly along canyon bottoms, and washes in hills and mountains, and sometimes abundant in washes of the valley floor.

Arizona, New Mexico, and northwestern mainland Mexico.

OP: Alamo Canyon, *Nichol 4 May 1939.* Bates Well, 18 Nov 1939, *Harbison 26156.* Estes Canyon, 2500 ft, 4 Nov 1978, *Bowers 1240.* 0.5 mi E of Lukeville, 11 Nov 1987, *Felger 87-317.*

Carlowrightia arizonica A. Gray
Lemilla. Figure 3.

Suffrutescent perennials or subshrubs with slender, delicate, brittle stems. Leaves drought deciduous, sessile to petioled, 0.6 (dry seasons)–5 (hot, wet weather) cm long; blades mostly lanceolate. Corollas about 1 cm wide, white with a yellow "eye" and purple nectar guidelines on the upper lip. Stamens 2. Flowering primarily late spring and during summer rainy season. The flowers open around sunrise, and the corollas and attached stamens fall as a unit with daytime heat. Capsules ca. 1 cm long, conspicuously narrowed at base (stipitate), flared and ovate- to cordate-discoid (latterly flattened) above, and glabrous. Seeds 4, ovate- to cordate-discoid, 3 mm wide, the surfaces conspicuously papillose.

Mostly on rocky slopes, but not the hottest, driest places, and sometimes along gravelly washes. Widespread in Organ Pipe and much of Cabeza Prieta. In open places it is frequently grazed by rabbits, rodents, and especially chuckwallas, which sometimes reduce the plant to a mass of short, stubby stems.

Southern Arizona to west Texas, widespread in Sonora, both states of Baja California, disjunct in Anza-Borrego in San Diego County, California, and through Mexico to Costa Rica. The geographic range essentially spans that of the entire genus. It is a "taxonomically complex species with numerous diverse morphological forms" (Daniel 1984: 167).

OP: Alamo Canyon, *Nichol 4 May 1939.* Estes Canyon, 9 May 1979, *Bowers 1695.* 0.5 mi N of Visitor Center, 16 Apr 1985, *Van Devender 85-110.* Quitobaquito Hills, 6 Apr 1988, *Felger 88-266.*
CP: Cabeza Prieta Tanks, 6 Apr 1979, *Lehto L23542* (ASU). Canyon at Agua Dulce Tank, and at Eagle Tank, 13 & 15 Jun 1992, *Felger* (observations).

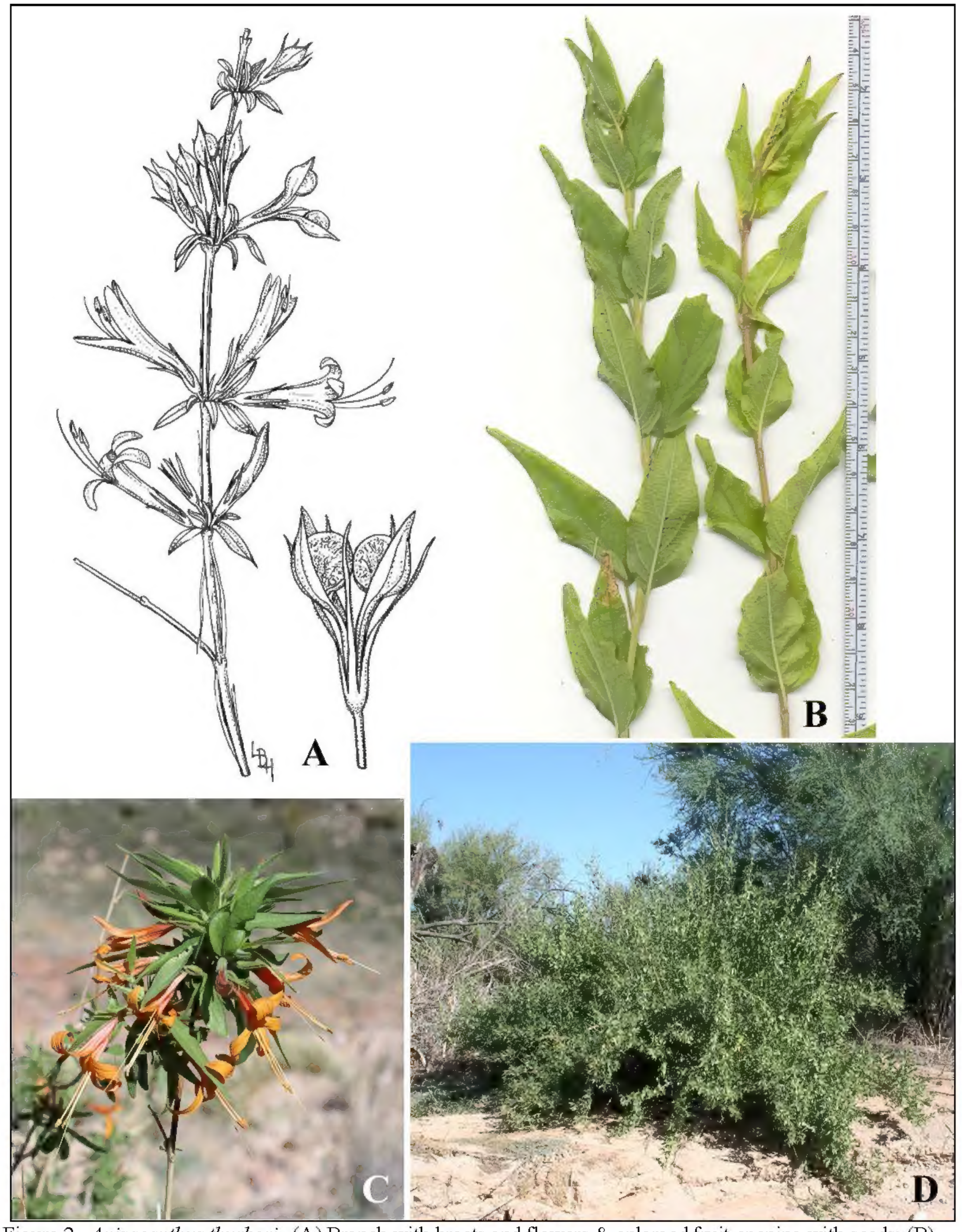

Figure 2. *Anisacanthus thurberi*. (A) Branch with bracts and flowers & enlarged fruit opening with seeds; (B) Cherioni Wash near Hwy 85, 25 Aug 2008; (C) Bull Pasture Trail, Ajo Mts, 27 Feb 2014; (D) Kuakatch Wash, W of Hwy 86, 7 Oct 2006.

Figure 3. *Carlowrightia arizonica*. (A) Flower, Bumblebee, Yavapai Co., photo by Max Licher; (B) Alamo Canyon, 7 Sep 2013.

Dicliptera resupinata (Vahl) de Jussieu
Fold-wing; *alfalfila*. Figure 4.

Herbaceous perennials, often bushy, and also flowering in the first season or year. Flowers enclosed by a pair of conspicuous, usually heart-shaped to nearly triangular or kidney-shaped bracts 7–15 mm long, these held on the plant long after the flowering season and sometimes becoming white. Corollas about 1–2 cm long, twisted through 180 degrees, pink or pale violet with white markings on the lip; flowering at various seasons; mostly winter dormant. Stamens 2. Capsules 4 mm long, obovoid, with 4 seeds.

Canyons in the Ajo and Diablo Mountains including Alamo, Arch, Diablo, and Estes Canyons, and high grassy slopes in the Ajo Mountains.

Western Mexico including Baja California Sur, Arizona and New Mexico.

OP: Alamo Canyon, *Nichol 4 May 1939*. Canyon Diablo, 15 Apr 1951, *Supernaugh 453*. Arch Canyon, 3500 ft, 28 Mar 1965, *Lockwood 163*. Near cliff overhanging Arch Canyon Trail, Ajo Mts, 2947 ft., 26 Oct 2003, *Rutman 20031026-23*.

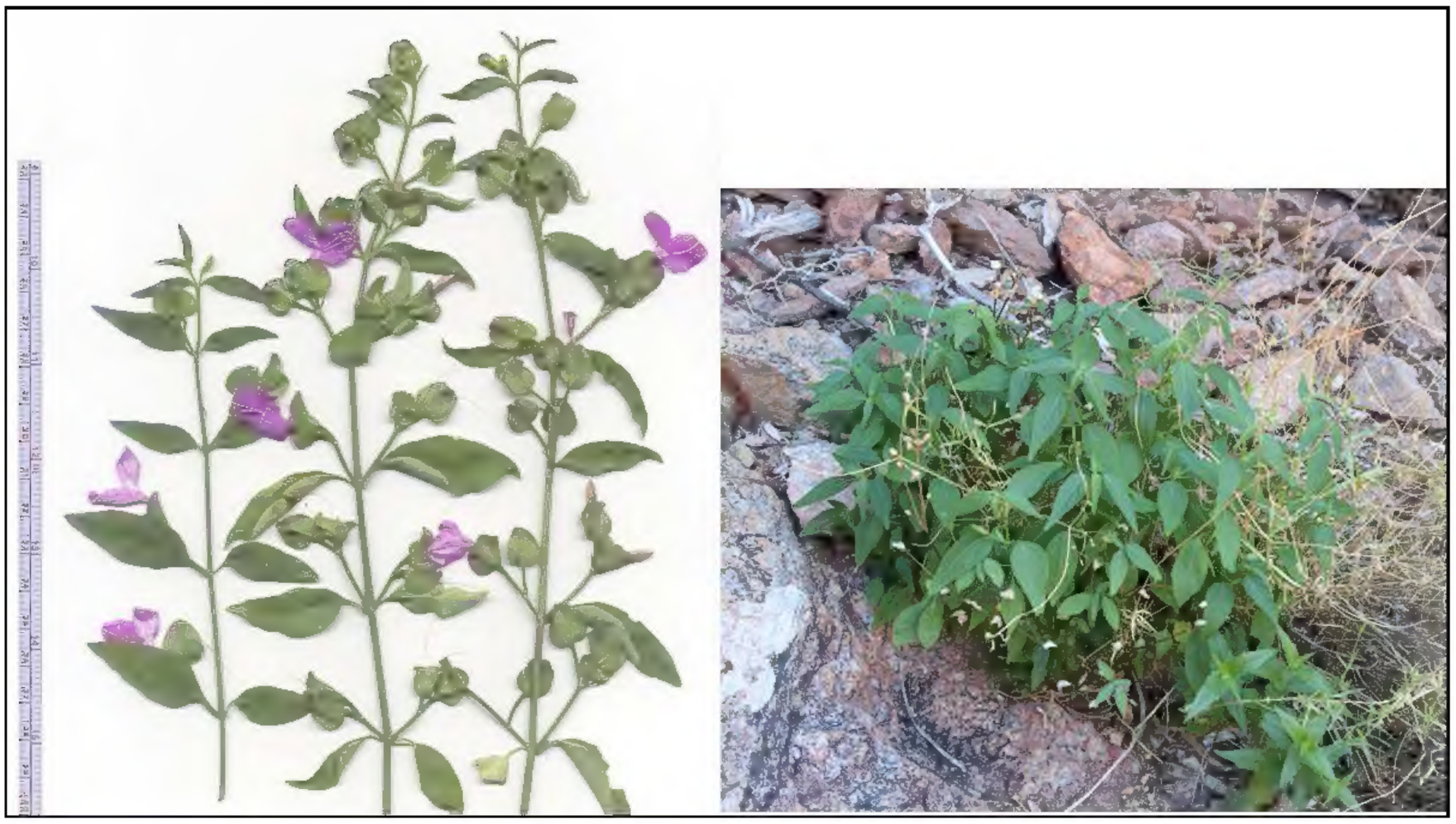

Figure 4. *Dicliptera resupinata*. (A) Garden in Ajo, 29 Sep 2013; (B) above the arch, Arch Canyon, 12 Sep 2013.

Justicia

Herbaceous perennials and shrubs. Flowers variously tubular. Stamens 2. Capsules with 4 or fewer seeds. This genus, mostly subtropical and tropical of about 700 species worldwide, is polyphyletic and the largest genus in the family. The New World species with closely related small genera of about 400 species are monophyletic (Kiel et al. 2013; McDade et al. 2000; McDade & Kiel 2006).

1. Herbaceous to suffrutescent perennials; flowers white, nocturnal. ..... **Justicia longii**
1. Shrubs; flowers red or red-orange, diurnal.

2. Stems bluish green for several seasons, generally sparsely leafy to essentially leafless, densely covered with microscopic hairs 0.05–0.1 mm long; corollas red-orange; capsules 16–22 mm long, pubescent. ..... **Justicia californica**
2. Stems brown after the first season, leafy, with hairs 0.2–1 mm long; corollas red with white markings on the lower lip; capsules 10–14 mm long, glabrous. ..... **Justicia candicans**

Justicia californica (Bentham) D.N. Gibson
[*Beloperone californica* Bentham]
Desert hummingbird bush; *chuparrosa*; wipisimal. Figure 5.

Sprawling to mound-shaped shrubs often 1–2+ m tall. Stems loosely interlacing, pale bluish green, densely pubescent with minute hairs. Often leafless or nearly so much of the year or with sparse foliage; leaves highly variable, 2–8 cm long, quickly drought deciduous, petioled, the blades mostly ovate to orbicular, often moderately thick. Corollas red-orange, 2.5–4 cm long, tubular and flaring above. Capsules 1.5–2 cm long, club-shaped, and pubescent. Seeds 4, rounded, 3–3.3 mm diameter, and glabrous. Flowering October to May with sufficient soil moisture and warm weather, often with massive flowering in February and March. As with various other desert acanths, the capsules tend to open with morning heat.

Widespread and common across the flora area, especially at lower elevations along dry watercourses and sometimes on bedrock slopes. This species is one of the more important hummingbird plants in the region and a favorite food of desert bighorn. Mornings during spring flowering often become hummingbird battlefields, especially along gravelly watercourses with palo verde (*Parkinsonia florida*), desert lavender (*Hyptis*), and ironwood (*Olneya*). The flowers attract Costa's, Rufous, and Allen's hummingbirds, as well as honeybees and butterflies. *Chuparrosa*, derived from *chupar* 'to suck', is used in Mexico for various hummingbird-adapted flowers (see Felger & Moser 1985). Carpenter bees (*Xylocopa*) and sometimes hummingbirds slit the floral tube and rob (consume) nectar, apparently without providing pollination (Maloof & Inouye 2000). Sweet nectar can be sucked from the flower base, mostly in spring, as a minor snack or trail food (Bean & Saubel 1972; Felger & Moser 1985).

Baja California Sur and northwestern Sinaloa northward to southeastern California and southwestern Arizona.

OP: Diablo Canyon, 21 Mar 1935, *Peebles 10825*. Alamo Canyon, *Nichol 26 Mar 1939*. Rancho Bonito, 2 Dec 1939, *Harbison 26208* (SD). Arch Canyon, 3500 ft, 28 Mar 1965, *Lockwood 153*. Senita Basin, along a wash, 6 Dec 1978, *Hodgson H205* (DES).

CP: Tule Tank, 24 Nov 1934, *Goodding 2074*. Papago Well, 15 Apr 1941, *Benson 10787*. Agua Dulce Pass, 19 Mar 1987, *Elias 10213*. Heart Tank, 27 Feb 1993, *Felger 93-165*.

TA: Tinajas Altas, 26 Mar 1932, *Shreve 5940*. SW side of Tinajas Altas range, bajada at granitic hills, 10 Jan 2002, *Felger* (observation).

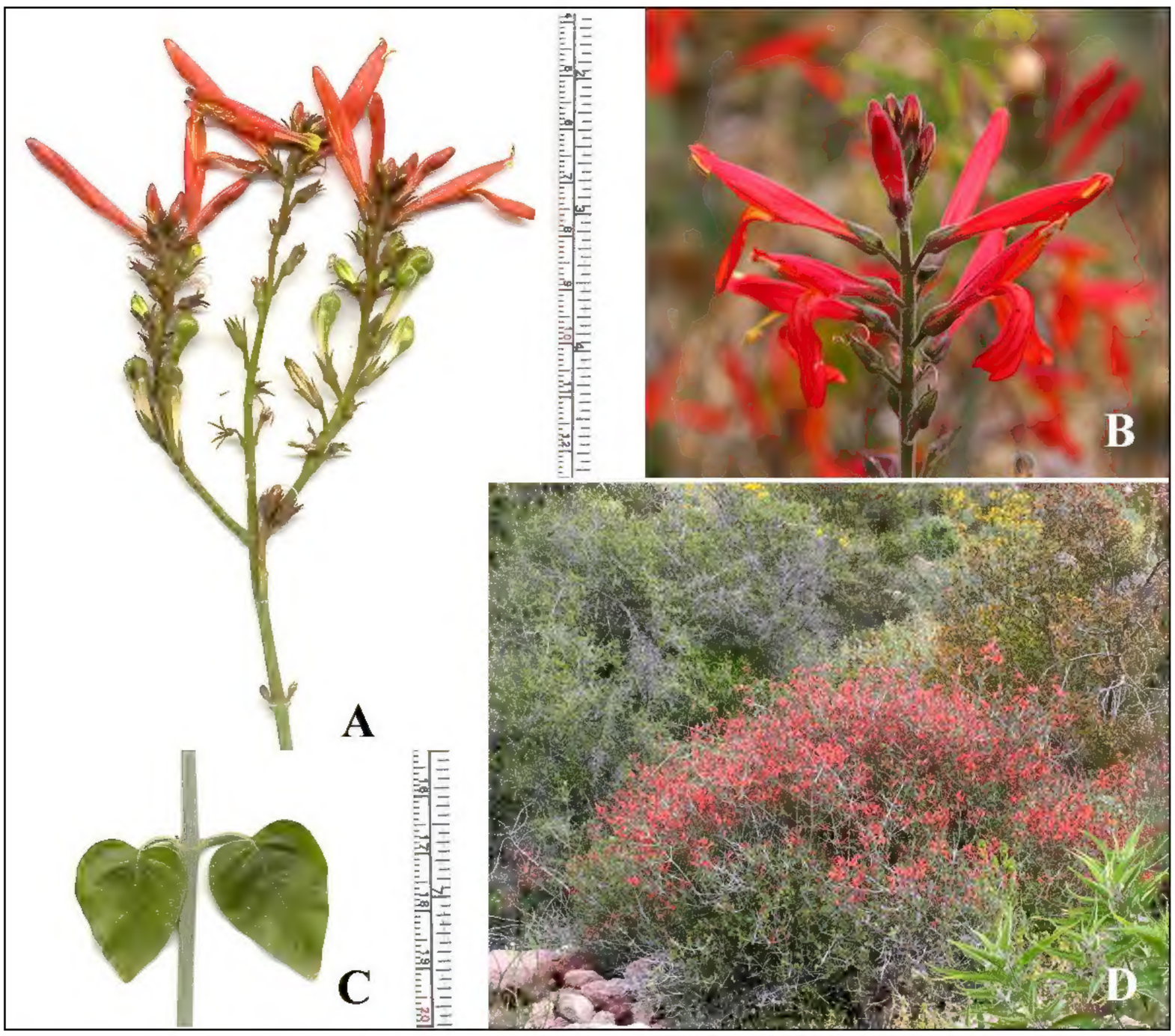

Figure 5. *Justicia californica*. (A & C) Garden in Ajo, 10 Feb 2009; (B) Estes Canyon Trail, 5 Feb 2006; (D) southern end of Sauceda Mts, along Pipeline Road, BLM, 18 Mar 2005.

Justicia candicans (Nees) L.D. Benson
[*Jacobinia ovata* A. Gray]
Chuparrosa. Figure 6.

Shrubs often 1–1.5 m tall, with slender, brittle, and leafy stems. Leaves gradually drought deciduous, 1.5–5+ cm long, petioled, the blades ovate and thin. Corollas often 2.5–3.5 cm long, bright red, with a slender tube and flared above with white markings on the lower lip. Capsules 10–15 mm long, glabrous. Seeds flattened, 3–4 mm diameter, and glabrous. Potentially flowering with sufficient soil moisture and warm weather, except during the summer rainy season when the plants produce vegetative growth; massive flowering often in February and March.

Canyon bottoms, often as an understory shrub, and rocky, north–facing slopes in the Ajo Mountains. It has been in the Ajo Mountains for at least 1200 years.

Southern Arizona to Oaxaca, and Baja California Sur.

OP: Pitahaya Canyon, *Nichol 23 Feb 1939*. Alamo Canyon, 13 Dec 1939, *Harbison 26250*. Puerto Blanco Drive, 22 Oct 1964, *Ranzoni 363* (ORPI). †Alamo Canyon, fruits, seeds, 1150 ybp.

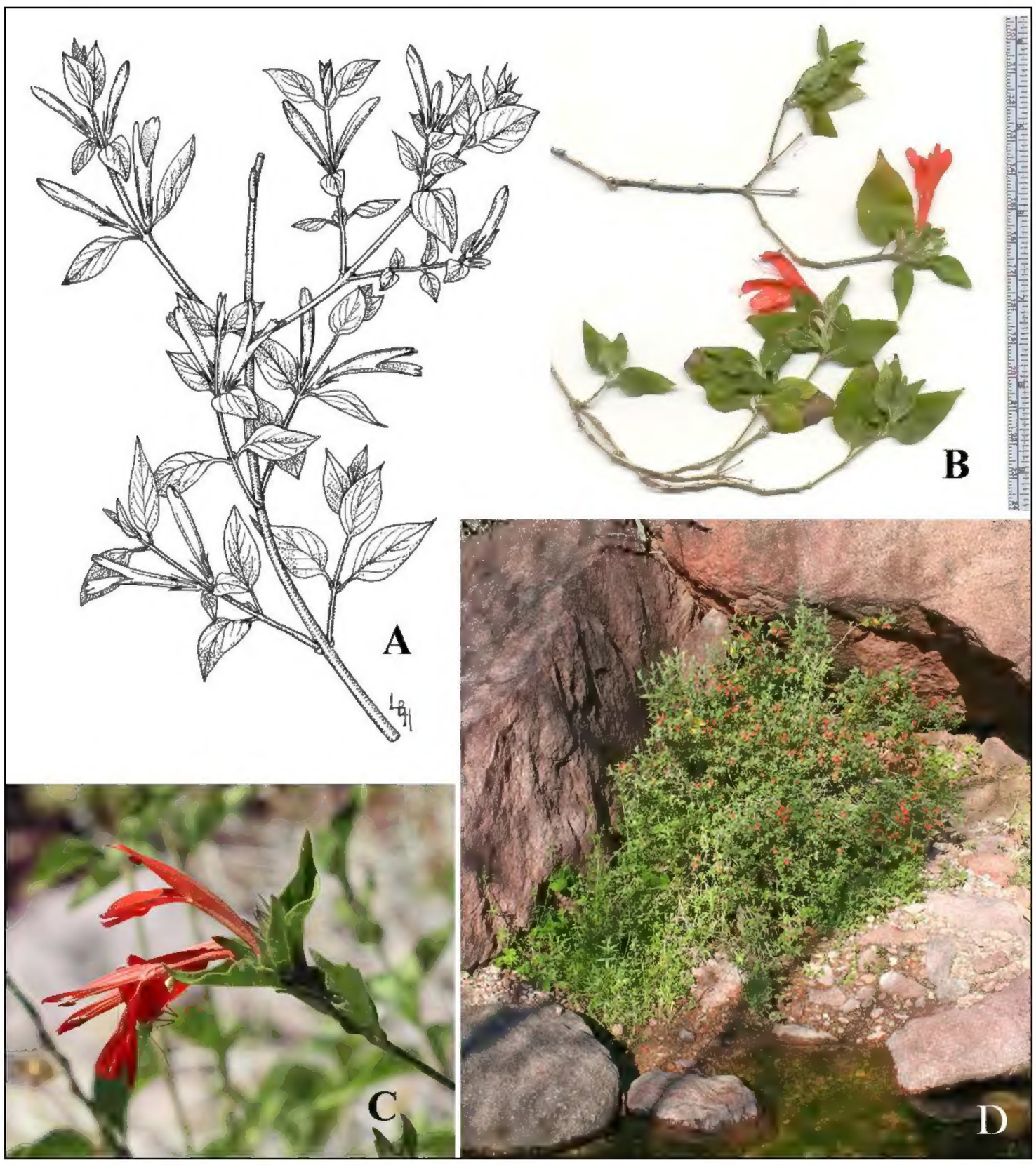

Figure 6. *Justicia candicans*. (A) Flowering branch. Alamo Canyon: (B) 24 Mar 2008; (C) 17 Oct 2013; (D) 12 Mar 2005.

Justicia longii Hilsenbeck
[*Siphonoglossa longiflora* (Torrey) A. Gray]
Long-flower tube-tongue. Figure 7.

Herbaceous perennials from a hard, knotty, and slightly woody base and short-rhizomatous rootstocks. Leaves and smaller stems drought deciduous. Leaves often 1–7 cm long, subsessile to petioled, the blades narrowly lanceolate (in winter) to elliptic or ovate (in summer). Flowers clustered in axils and surrounded by firm, persistent bracts. Flowers nocturnal, opening in the early evening; corollas and attached stamens falling shortly after dawn; corollas 3.5+ cm long, pure white with a prominent, slender tube. Capsules 6.5–10 mm long. Seeds flattened, 2+ mm diameter, tuberculate. Flowering during spring and summer. The plants are often severely grazed by wildlife. The flowers, like those of other *Justicia*, are not fragrant.

Rocky and gravelly soils, canyons and slopes, especially north-facing. Documented for the Puerto Blanco and Ajo Mountains and other scattered localities in Arizona Uplands in Organ Pipe.

Southern Arizona and west Texas, and Sonora north of the Guaymas region. Sphinx moths, the presumed pollinators, have been observed feeding at the flowers (Hilsenbeck 1990).

OP: Above Dripping Springs, 16 Apr 1952, *Parker 9753*. Estes Canyon, *Warren 9 May 1975*. Walls Well Rd, *Van Devender 30 Aug 1978*. Bull Pasture, 2700 ft, 9 May 1979, *Bowers 1693*. Arch Canyon, 11 Mar 1983, *Daniel 2590* (ASU).

Ruellia nudiflora (Engelmann & A. Gray) Urban
[*R. nudiflora* var. *runyonii* (Tharp & F.A. Barkley) B.L. Turner]
Violet Ruellia. Figure 8.

Herbaceous perennials from rhizomatous rootstocks; winter dormant. Leaves often 5–17 cm long, petioled, the blades ovate to broadly ovate. Inflorescences terminal, paniculate, openly branched with slender branchlets. Flowers showy, the corollas violet-purple, 3–5 cm wide, only moderately bilaterally symmetric; warmer months. Stamens 4. The flowers open near sunrise and the corollas with their attached stamens fall away with daytime heat, often about midday or early afternoon. Capsules firm and ellipsoid, about 1–2 cm long, usually with 10 or more seeds; opening explosively. This species also produces cleistogamous flowers (self-fertilizing flowers forming fruits without the flowers opening) near the base of the plants, especially early in the growing season or at times of stress.

Locally in the eastern and northern portions of Organ Pipe. Often in shady places including canyon bottoms to high elevations in the Ajo Mountains, and mesquite bosques such as Dos Lomitas and Armenta Ranch and other low-lying habitats with clayish or silty soils. The flowers are visited by bees.

Arizona and Texas to Mississippi, and Mexico to Costa Rica.

This species has been called "violet wild petunia," an unfortunate name because *Petunia* is a genus in the potato family (Solanaceae). The showy flowers and winter hardiness make *Ruellia* a favorite in native plant gardens in southern Arizona.

OP: 2 mi SE of Walls Well, near N end of Ajo Mts, abundant along sandy wash, 30 Aug 1945, *Haskell 3215*. Canyon Diablo, 15 Apr 1951, *Supernaugh 431* (ORPI). Ajo Mts, 20 Aug 1952, *Fouts 431*. Arch Canyon, 3500 ft, 28 Mar 1965, *Lockwood 163*. Armenta Well, *Wirt 10 Aug 1990* (ORPI). Dos Lomitas, *Rutman 16 Aug 2001* (ORPI).

Figure 7 *Justicia longii* (A) Bull Pasture Trail, 31 Mar 2008, (B & D) Ajo Mt Drive near Wild Horse Tanks, Diablo Mts, 14 Sep 2013, (C) Estes Canyon, 30 Jan 2014

Figure 8 *Ruellia nudiflora* Ditch along Hwy 86 east of Why (A) 22 Sep 2008, (B & C) 16 Aug 2006

ADOXACEAE – Adoxa Family

****Sambucus cerulea** Rafinesque

[*S. nigra* Linnaeus subsp *cerulea* (Rafinesque) Bolli *S. mexicana* C Presl ex de Candolle *S. cerulea* var *mexicana* (C Presl ex de Candolle) L D Benson *S. neomexicana* Wooton *S. cerulea* var *neomexicana* (Wooton) Rehder]

Blue elderberry, *tápiro* Figure 9

Small trees with thick trunks and limbs, the wood soft and weak, the stems pithy Leaves deciduous in summer, new growth and leaves appear in fall and winter Flowers cream white in dense, often flat-topped inflorescences (cymes), flowering mostly winter and spring Fruits berry-like, about 5 mm in diameter, dark purplish to black

The one record in the flora area might have been a tree planted at the former ranch in Alamo Canyon. Elderberry trees often were planted at ranches and towns in southern Arizona and northern Sonora, largely for the berries, which are mostly made into preserves, jelly, and wine, and also used for medicinal purposes. It served Hia-Ced O'odham people "as a medicine and sometimes for food" (Betty Melvin in Zepeda 1985: 65). The unripe fruits and herbage can be poisonous.

Blue elderberry is probably native to the Sonoran Desert Region but at elevations above the desert. *Sambucus cerulea* occurs in western North America including northwestern Mexico. Eriksson and Donoghue (1997: 567) report that "our accessions of *Sambucus nigra* sensu Bolli (1994) form a clade with the exception of *S. cerulea*, which we conclude should be treated as a separate species."

The genus includes about 10 species in the Old and New World, mostly temperate and subtropical or montane in the topics. The fruits have been used as a source of blue or black dye, especially by the Romans. Pan was said to dye his hair using elderberries.

OP Alamo Canyon, *Tinkham Apr 1942*

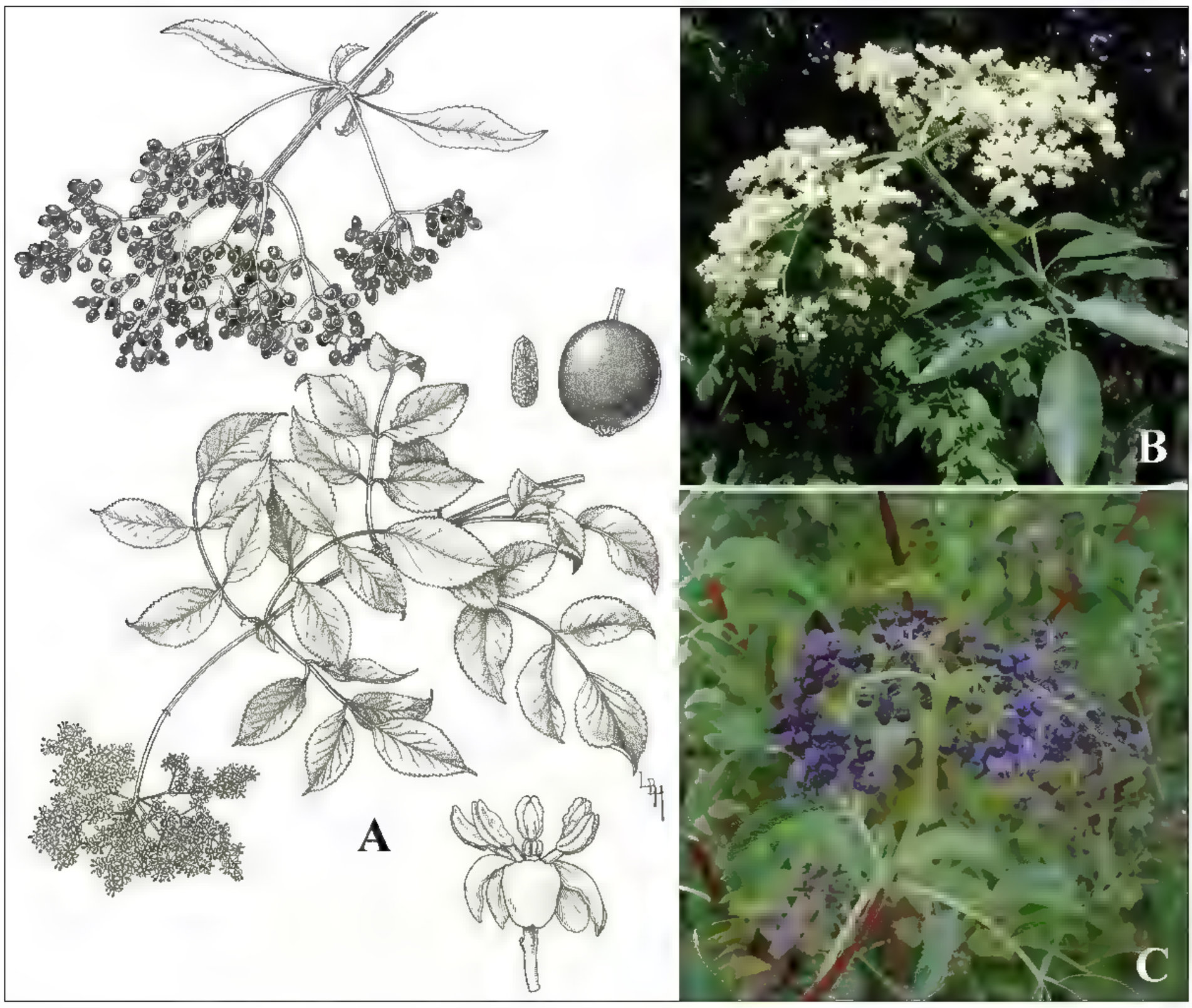

Figure 9 *Sambucus coerulea* (A) By LBH (B) Oak Creek Canyon, Coconino Co., (C) Sedona, Coconino Co Photos by Max Licher (SEINET)

AIZOACEAE Aizoon Family

Low-growing and generally weedy annuals in the flora area. Leaves opposite (those in the flora area). Flowers radial. Sepals mostly 5. Petals none but numerous petal-like linear staminodes (modified stamens) often present. Fruits of capsules.

1. Winter-spring annuals; plants extremely succulent; flowers white with numerous slender petal-like staminodes; capsules opening at the top. ..... **Mesembryanthemum**
1. Summer-fall annuals; plants not succulent or sometimes semi-succulent; flowers pinkish, the calyx 5-lobed, staminodes none; capsules opening around the middle ..... **Trianthema**

*Mesembryanthemum

Iceplant; *hielitos*

Plants extremely succulent. Flowers with numerous, slender, petal-like staminodes; fertile stamens many. Fruits at first fleshy, becoming dry capsules with valves at the flattened top opening when moist.

Two species of this South African genus are naturalized in portions of the Sonoran Desert where they occur as winter-spring annuals. Both species were first found in Organ Pipe in spring, 1995, an El Niño year with copious spring rains. They became locally established on hypersaline soil, straddling the U.S. Mexico border and were more widespread and abundant on the Mexico side, especially along Mexico Highway 2. These species are occasionally seen elsewhere in southern Arizona and are especially common in sandy soils around Puerto Peñasco in northwestern Sonora. Both species are extensively naturalized along the Pacific Coast of the Californias and South America, and other Mediterranean regions including southern Australia.

1. Leaves with a thick but broad blade, and an evident petiole.... **Mesembryanthemum crystallinum**
1. Leaves cylindrical, sessile (petiole and blade not distinguishable)
..... **Mesembryanthemum nodiflorum**

*Mesembryanthemum crystallinum Linnaeus

[*Cryophytum crystallinum* (Linnaeus) N.E. Brown. *Gasoul crystallinum* (Linnaeus) Rothmaler]

Crystal iceplant; *hielitos*. Figure 10.

Plants spectacularly fleshy, the surfaces covered with large, watery, crystal-like vesicles. Leaves often 2 10 cm long, narrowed basally or with a petiole; blades usually obovate to broadly spatulate, or somewhat triangular. Flowers ca. 1 cm wide with white staminodes. Capsules ca. 1 cm wide, rounded like a clenched fist when dry, quickly gaping open by slit-shaped valves when wet (even on years-old dry specimens) to reveal the seeds and closing again when dry. Seeds 1 mm in diameter and numerous.

Locally abundant on saline soils along the international border in the south central to southwestern part of Organ Pipe.

Native of southern Africa. It has been in southern Arizona since the early 20th century and at Puerto Peñasco and elsewhere in northwestern Sonora at least since the 1970s (Felger 2000; Felger & Wilder 2012).

OP La Abra Plain, near International Boundary Monument 170, *Rutman 11 May 1995*

Figure 10 *Mesembryanthemum crystallinum*. All images from the Rio Sonoyta floodplain near international boundary, Sonora, 28 Mar 2013

***Mesembryanthemum nodiflorum** Linnaeus
Slender-leaf iceplant, *hielitos*. Figure 11

The plants turn bright red with heat and drying conditions. Leaves slender, more or less terete, and extremely succulent. Flowers ca. 5 mm wide, the staminodes white, becoming yellow as the flower fades. Capsules obovoid, ca. 5 mm wide, seeds brown, 0.7–0.8 mm in diameter, numerous. No herbivory has been noted, despite the plants' succulence.

Southwestern margin of Organ Pipe on saline soils, from La Abra Plain to Hocker Well and Corner Well and the adjacent southeastern corner of Cabeza Prieta, and adjacent northwestern Sonora. The population southward from the southwest corner of Organ Pipe extended as far as the eye could see, covering hundreds if not thousands of acres, much of it not disturbed.

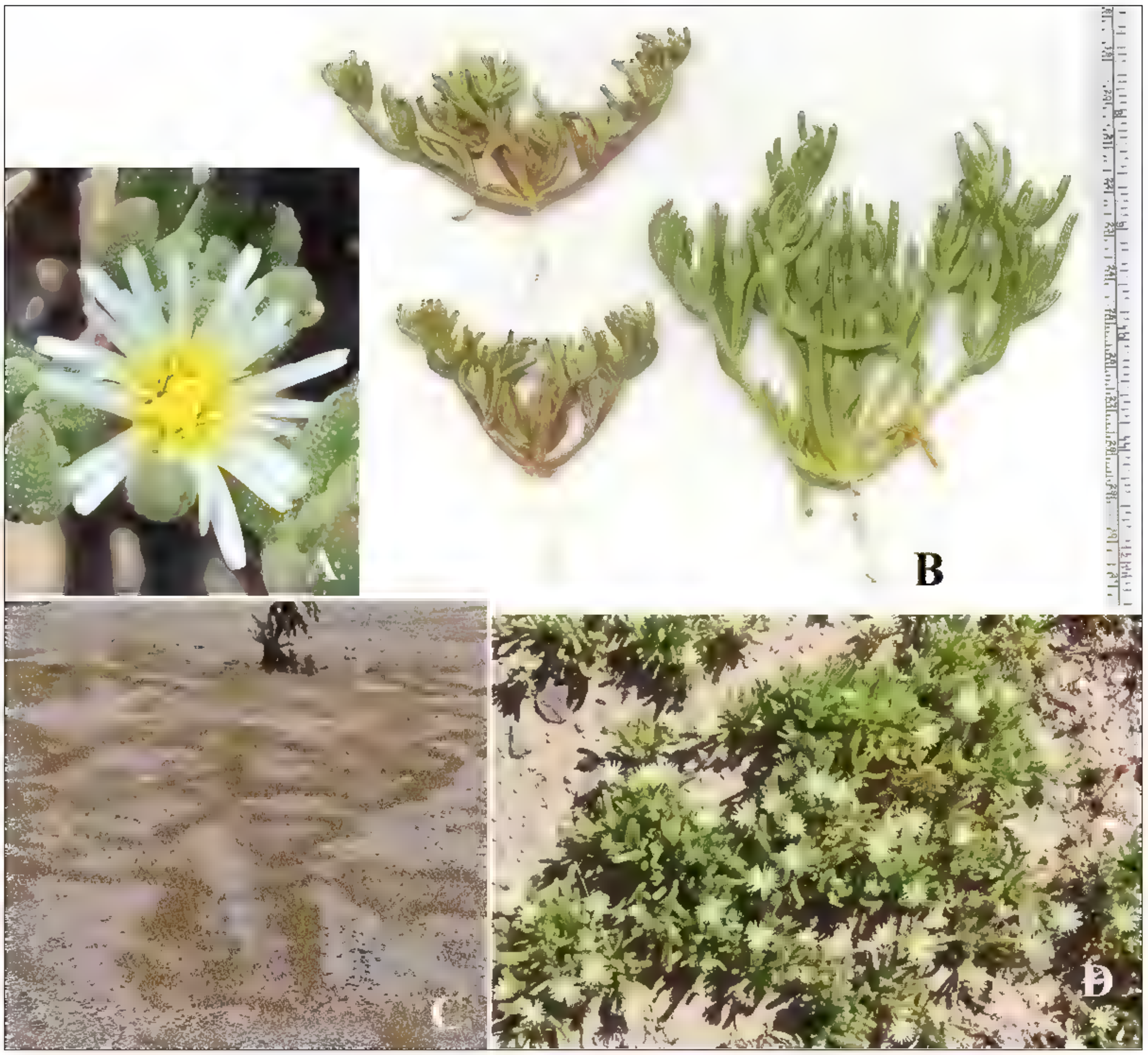

Figure 11 *Mesembryanthemum nodiflorum* (A & D) International boundary near El Huerfano, Sonora, 5 Mar 2014, (B) La Abra Plain, 19 Mar 2008, (C) near SW corner of Organ Pipe, 23 Jul 2008

Native to southern Africa In the New World naturalized along the Pacific Coast of the Californias and South America First recorded in Arizona in the early 1980s (8 mi N of Maricopa, *Hamilton 17 Mar 1983*)

OP La Abra Plain, probably more than 10,000 plants, near International Boundary Monument 170, *Rutman 11 May 1995* S boundary from Hocker Well to Corner Well, 11 May 1995, *Rutman*, photos
CP Near Corner Well, 11 May 1995, *Rutman* (observation)

Trianthema portulacastrum Linnaeus
Horse purslane, *verdolaga de cochi*, kasvañ Figure 12

Hot-weather ephemerals, often reddish, sometimes semi-succulent Stems often 15 60 cm long Leaves 3 4 5 (9) cm long on robust, young plants, the older plants with smaller and usually thicker leaves, leaf blades obovate to orbicular, stipules and expanded leaf bases forming a membranous sheath around the stem Flowers small, sessile and solitary in leaf axils, partially enclosed by the sheathing leaf base, calyx petal-like, 5-lobed, the lobes 2 3 12 5 mm long, pink with

a green horn. Capsules circumscissile, the base corky, and the "lid" or "cap" truncate or more often 2-horned, retaining 1 or 2 seeds. Capsules several-seeded; seeds about 7 in number, and 2 mm long. The seeds disperse three ways: 1 or 2 seeds disperse with the capsule cap, and the others remain with the basal part of the capsule and dribble away or remain with the capsule attached to the mother plant.

Figure 12 *Trianthema portulacastrum* (A) Plant with enlarged fruit, flower, and seed, (B) near Quitobaquito, 11 Sep 2008, (C) near Quitobaquito, 20 Aug 2006, (D) Gila River near Gillespie Dam, 31 Mar 2013

Temporarily moist places at lower elevations, especially in hypersaline soils; disturbed habitats, washes, low places, and alkaline flats. The specimen records are from the southern margin of flora area, perhaps as a result of dispersal from disturbed habitats in nearby Sonora.

Horse purslane is widespread across the Sonoran Desert even in remote, natural habitats (Felger & Wilder 2012). Widely distributed and often weedy in the Americas. Some authors propose that it may be introduced from the Old World in post-Columbian times. It ranges across large areas of the Old World and is a serious agricultural weed worldwide (e.g., Holm et al. 1997).

Two forms are evident in the flora area and elsewhere in the Sonoran Desert (Felger 2000): a robust form, with larger leaves and flowers, and a more common form with smaller leaves and flowers. Both occur intermixed, and intermediate forms appear to be absent. Perhaps related to the two Sonoran Desert forms are two biotypes well known in India, the red, or *rubra*, form and the green, or *flava* form (e.g., Mohammed & Sen 1990).

OP Williams Spring, *Van Devender 30 Aug 1978* 0.5 mi W of Lukeville, 10 Nov 1987, *Felger 87-284*. Aguajita 14 Sep 1988, *Felger 88-430* (larger-flowered morph), *88-431* (smaller-flowered morph)
CP Adobe Well (Simmons 1966)

AMARANTHACEAE Amaranth Family (includes Chenopodiaceae)

Annuals to woody shrubs. Leaves alternate or opposite, simple, often entire; stipules none. Flowers small and mostly inconspicuous, bisexual or unisexual; sepals (tepals) usually 4 or 5, often dry and membranaceous; petals none. Fruits 1-seeded.

1. Shrubs, obviously woody (borderline cases will key both ways).

2. Leaves flat, or at least broader than thick; twigs not succulent, often woody; flowers unisexual, the female flowers and or fruits winged. ..... **Atriplex**
2. Leaves succulent, rounded in cross section but the upper surface often somewhat flattened, about as thick as wide; twigs semi-succulent, not woody and not spinescent; flowers bisexual, the female flowers and fruits not winged. ..... **Suaeda**

1. Plants herbaceous or only slightly woody at base.

3. At least some leaves opposite or appearing opposite (some leaves may be alternate or appear to be 3's in *Tidestromia*); flowers bisexual.

4. Plants with branched hairs; leaves with conspicuous petioles, the blades generally about as wide as long, broadly ovate to obovate-orbicular.....**Tidestromia**
4. Plants glabrous or with simple hairs; leaves sessile or short-petioled, more than twice as long as wide, linear to elliptic or oblanceolate.

5. Annuals, not succulent, with simple hairs or sometimes glabrate with age; leaves narrowly elliptic or oblanceolate to oblong.....**Gomphrena**
5. Perennials, markedly succulent and glabrous; leaves linear..... **Nitrophila**

3. Leaves alternate; flowers unisexual or bisexual.

6. Winter-spring annuals; leaves hastate lanceolate-linear (at least the lower, larger leaves); flowers with 1 stamen and 1 sepal. ..... **Monolepis**
6. Spring or summer annuals; leaves not hastate lanceolate-linear; stamens and sepals more than 1.

7. Female flowers and fruits enclosed in 2 sepal-like bracts. ..... **Atriplex**
7. Female flowers and fruits not enclosed in sepal-like bracts or the bracts.

8. Leaves and younger stems with soft, white hairs; fruiting calyx lobes hooked at tips. ..... **Bassia**
8. Plants glabrous, glaucous, or mealy but lacking slender white hairs; calyx lobes not hooked.

9. Leaves sessile or subsessile, narrowly linear or scale-like. .....**Salsola**
9. Leaves petioled, the blade expanded and much wider than petioles.

10. Flowers unisexual..... **Amaranthus**
10. Flowers bisexual.

11. Plants not stinky; leaves dark green to red-green and shiny on both surfaces, or sometimes grayish below; seed margins acute (thin) with a distinct "rim"; seed surface dull even after removal of pericarp. .... **Chenopodiastrum**
11. Plants stinky, even when dry; leaves pale-colored and mealy on both surfaces; seed margins obtuse (broad); seed surface shiny blackish after removal of pericarp. ..... **Chenopodium**

Amaranthus

Annuals with a well-developed taproot. Leaves alternate, petioled. Flowers small and unisexual. Fruits small, indehiscent utricles or circumscissile (splitting around the middle) capsules. Seeds lens-shaped and compressed, erect in the fruit, smooth, red-brown to blackish (usually white or light colored among domesticated grain amaranths that probably were grown in the flora area in prehistoric times; Felger 2007; Rea 1997).

Five amaranths occur in the flora area, although only *A. fimbriatus* and *A. palmeri* are common and widespread. These two species tend to produce a single main stem. *Amaranthus palmeri* has female and male flowers on separate plants (dioecious). The others produce both female and male flowers on the same plant (monoecious), and the male flowers generally fall away soon after the pollen is shed. Among *A. albus* and *A. crassipes* the apical meristem is often not dominant, resulting in the lateral branches being as large or larger than the main axis. In *A.* ×*tucsonensis* the branching habit may be somewhat intermediate. *Amaranthus crassipes* has indehiscent fruits, and the others have dehiscent, circumscissile capsules (the fruit separates at a "line" around the middle and the top falls away like a miniature cap).

1. Stems erect, ascending, procumbent or prostrate; inflorescence branches and pedicels often thickened and moderately to strongly wavy (sinuous) and or corky; fruits dehiscent or not, rough or sculptured at least towards the tip.

2. Peduncles markedly thickened and corky, forming an unique compact, hard knotty structure at the base of the plant and smaller clusters form in the leaf axils; fruits indehiscent. .....**Amaranthus crassipes**
2. Peduncles not conspicuously corky as above; fruits dehiscent (capsules).

3. Bracts beneath (subtending) flowers often spine-tipped and conspicuously longer than the flower; female flowers with 3 sepals. ..... **Amaranthus albus**
3. Bracts usually not spine-tipped and usually shorter than, or as long as the flower; female flowers with 5 sepals. .....**A.** ×**tucsonensis**

1. Stems usually erect or ascending, the plants often robust; inflorescence branches and pedicels mostly straight (the inflorescence branch tips often drooping), not thickened and corky; fruits dehiscent (circumscissile), smooth-surfaced.

4. Male and female flowers on the same plant; inflorescences "soft," the bracts not spiny or firm; female sepals conspicuously fringed; stamens 3. .....**Amaranthus fimbriatus**
4. Male and female flowers on different plants; inflorescence bracts (not sepals) firm and often sharp; female sepals not fringed; stamens 5. .....**Amaranthus palmeri**

***Amaranthus albus** Linnaeus
[*A. graecizans* of authors, not Linnaeus]
Pigweed, tumbleweed pigweed. Figure 13.

Robust, weedy plants, to ca. 80 cm tall, at maturity sometimes becoming tumbleweeds. Stems often yellowish. Female flowers with 3 sepals and dehiscent fruits. Male flowers with 3 stamens. Fruits of dehiscent, circumscissile capsules.

Common in urban and agricultural areas just south of Organ Pipe in the Sonoyta region and occasionally spreading into the border region of Organ Pipe east of Lukeville (Felger 1990, 2000). The 1939 record from the Ajo Mountains was the only record until 2013, when it was found in abundance in several miles of Alamo Canyon after the major flood of September 2012 (Rutman, 2 Nov 2013, photos).

Widespread and weedy in many parts of the world, in the New World from Alaska and Canada to South America; probably native to tropical parts of North America. Plants in southern Arizona and northern Sonora are probably var. *pubescens* (Uline & W.L. Bray) Fernald, distinguished by being sticky (viscid-pubescent, the hairs glandular) and having crisped leaf margins.

OP Ajo Mts, *Harbison 13 Dec 1939* (SD)
Sonora Ejido Morelia, ca 8 km W of Sonoyta and 0 5 km N of Río Sonoyta (1 5 mi by road S of MEX Hwy 2), common weed, to 80 cm, 11 Nov 1987, *Felger 87-306*

Amaranthus crassipes Schlechtendal var. **crassipes**
Spreading amaranth. Figure 14.

Plants highly variable in size, but mostly less than 20 30 cm across. Stems often semi-succulent, especially on larger plants, mostly prostrate, or sometimes turning upward at the tip (procumbent) or the central stem erect. Female flowers with 5 sepals. Male flowers with 3 stamens. Fruits indehiscent.

Wet clayish or silty soils of playas, wash banks, and dirt tanks in at least four places in the western part of the flora area following favorable summer or early fall rains. The population in Las Playas is extensive and the plants are often browsed, probably by rabbits.

Figure 13 *Amarantnus a.bus* Alamo Canyon (A & B) 2 Nov 2013, (C & D) 2 Nov 2013

Figure 14 *Amaranthus crassipes* San Cristobal Wash at Camino del Diablo, 26 Sep 2013

Variety *crassipes* occurs in southeastern United States, West Indies, northern South America, and southern and eastern Mexico, and is disjunct (native?) in northwestern Sonora and southwestern Arizona where it is known from relatively few localities Another variety occurs in Texas, Coahuila, and Chihuahua

OP Old field, Armenta Well Ranch, 13 Sep 1978, *Bowers 1531* (ORPI)
CP Jose Juan Tank, wet mud, 14 Sep 1992, *Felger 92-713* Las Playas, 28 Nov 2001, *Felger 01-547* San Cristobal Wash, where Camino del Diablo/Bates Road crosses the wash, *Rutman 26 Sep 2013*
TA Coyote Water, 25 Oct 2004, *Felger 04-24.*

Amaranthus fimbriatus (Torrey) Bentham ex S Watson
Fringed amaranth, *bledo*, *quelitillo*, cuhukkia i vakĭ Figure 15

Summer-fall annuals, less than 1 m tall, the plants sometimes persisting until the first frost of late fall or winter, glabrous, pale green or often reddish especially late in the season Leaves narrowly lanceolate Inflorescences bracts and sepals herbaceous, not prickly Female and male flowers on the same plant Female flowers green and white, urn-shaped, the sepals 5 and fringed (fimbriate, rarely essentially entire) Stamens 3 Fruits of dehiscent, circumscissile capsules Seeds 0 85 1 mm wide, lens-shaped, red-brown to blackish

Common and widespread, especially at lower elevations, often on sandy soils, washes and valley plains, dunes, bajadas, floodplains, roadsides, and sometimes on rocky slopes Widespread in the flora area for at least 32,000 years

Sinaloa and Baja California Sur to southwestern United States

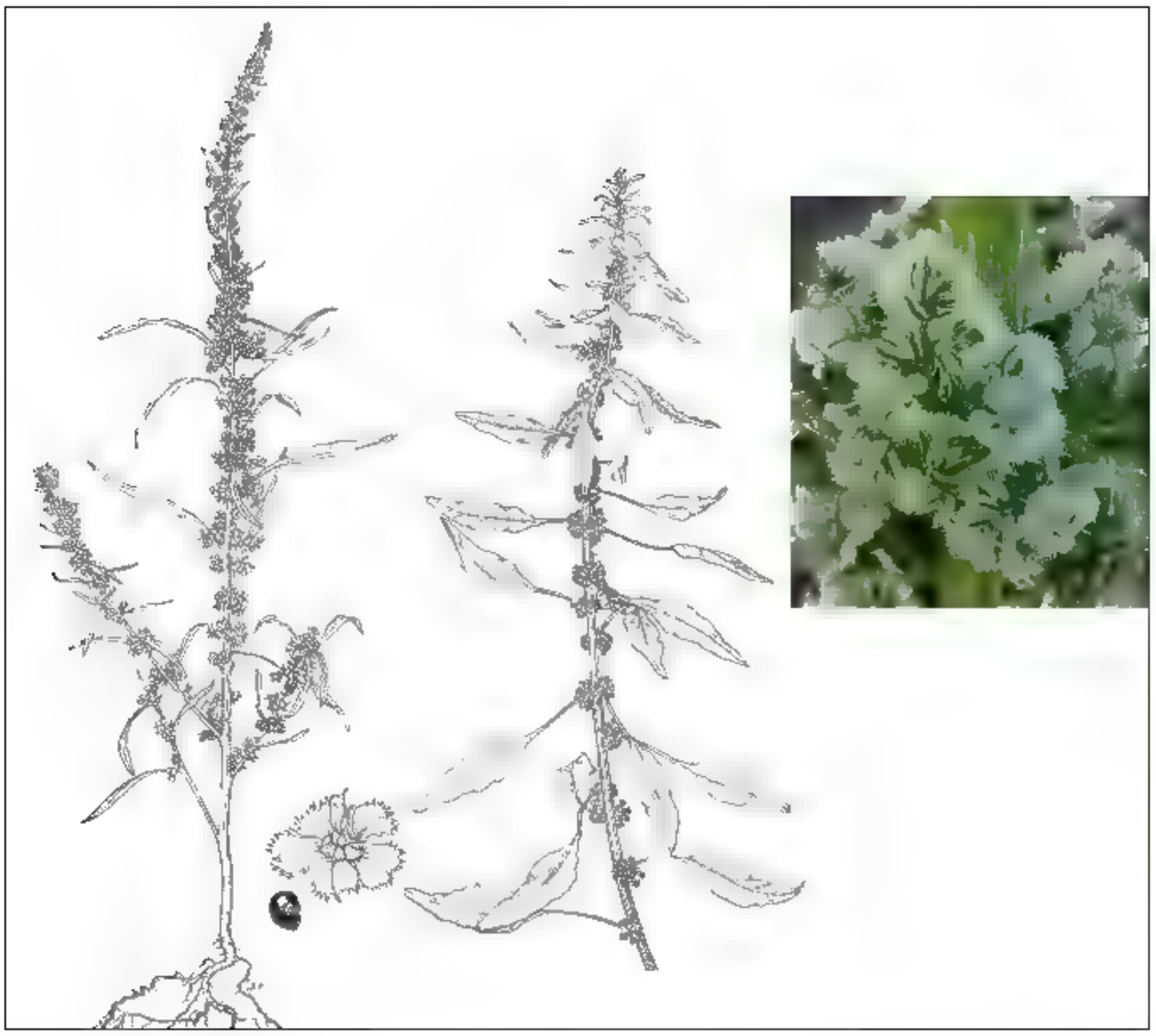

Figure 15 *Amarantnus fimoriatus* (A) Plant, branch, female flower, and seed, (B) Kuakatch Wash near Hwy 85, 8 Sep 2006

OP Bates Well, *Harpison .9 Nov .959* (SD). S of Estes Canyon, 12 Sep 1978, *Bowers .520* Aguajita Wash, 14 Sep 1988, *Fe.ger 88 4.6* †Alamo Canyon, fruits, seeds, 1150 to 32,000 ybp (3 samples). †Montezuma's Head, fruits, seeds, 13,500 to 21,840 ybp (3 samples)

CP Daniels Arroyo at Charlie Bell Road crossing, 18 Aug 1992, *Fe.ger 92 663* Bates Well Road at E boundary of Refuge, 14 Sep 1992, *Fe.ger 92 679* (CAB) Pinacate Lava, 15 Sep 1992, *Fe.ger 92 772* Pinta Sands, 1 Feb 1992, *Fe.ger* (observation)

TA Tinajas Altas, 26 Oct 2003, *Fe.ger* (observation) Coyote Water, 25 Oct 2004, *Fe.ger 04 25* †Butler Mts, fruits, seeds, 8160 ybp

Amaranthus palmeri S Watson

Careless weed, pigweed; *quelite de las aguas*; cuhugia Figure 16

Well-watered plants reaching 1 1 6+ m tall, otherwise mostly smaller, sometimes only 5 10 cm tall, glabrous or essentially so Terminal inflorescences commonly drooping near the tip (except young or very small plants), female and male flowers on separate plants Female plants with spinescent bracts and sepals, the sepals 5 Stamens 5 Fruits of dehiscent, circumscissile capsules Seeds 1 mm wide, lens-shaped, red-brown to blackish

Common and widespread, and seasonally abundant, roadsides and other disturbed areas, washes and arroyo bottoms, dirt tanks (*charcos*), and valley bottoms, and sometimes even on rocky slopes It has been in the Ajo Mountains for at least 1200 years

Southwestern United States and much of Mexico, weedy and adventive worldwide

This abundant, often robust summer annual was a major food plant across much of the Sonoran Desert Young or half-grown plants were consumed as greens (Betty Melvin in Zepeda

1985: 56), and the small, black seeds of mature plants were parched and ground. Fresh plants were sometimes baked in coals or cooked and rolled "into a ball and baked on hot coals; this could be stored for future use" (Castetter & Bell 1951: 201). The seeds, seed-bearing branches, or entire plants were often stored. Betty Melvin said, "we would cook it. Yes that's the plant you have to wash and wash to get all the dirt out and then you boil it, you boil the little leaves until they are tender and then you refry it with some onions and it's very good. If you mix it with some cheese it's even better" (Zepeda 1985: 56).

OP: Bates Well, *Harbison 19 Nov 1939* (SD). Dos Lomitas, *Warren 17 Nov 1974*. S of Estes Canyon, 12 Sep 1978, *Bowers 5122*. Aguajita Wash, 14 Sep 1988, *Felger 88-44*. †Alamo Canyon, stems, fruits, seeds, 1150 ybp.

CP: Pinacate lava flow, 22 Mar 1992, *Harlan 120* (CAB). O'Neill's Grave, 11 Apr 1992, *Harlan 183* (CAB). Daniels Arroyo at Charlie Bell Rd, 18 Aug 1992, *Felger 92-665*. San Cristobal Wash, 14 Sep 1992, *Felger 92-688*.

TA: No records but expected at least along Coyote Wash.

Figure 16. *Amaranthus palmeri*. (A) Plant, branch, female flower (below), male flower (above), and seed, (B), male flowers, Hwy 85 roadside, mile 20 between Ajo and Gila Bend, 6 Sep 2013, (C) Alamo Canyon, 15 Sep 2013, (D) Growler Canyon, Bates Mts, 9 Sep 2012.

Amaranthus ×tucsonensis Henrickson
Tucson amaranth Figure 17

Plants often bright pink, generally erect, often with a main axis but also often with well-developed lateral branches Flower clusters axillary and also with many small, crowded clusters in the terminal axis, but the terminal flowering stem or inflorescence not drooping (as often seen in *A. palmeri*), flower clusters and flowers not spinescent Bracts beneath (subtending) female flowers mostly shorter than, to about as long as the sepals Female and male flowers on the same plant Female flowers with 5 sepals, the sepals relatively broad although moderately narrowed at the base but not narrowly clawed, the sepals at first rather erect and with age spreading or reflexed Male flowers with 5 stamens Fruits of dehiscent, circumscissile capsules

The Organ Pipe collections are from Ajo Mountain canyons and Armenta Well Ranch The collection history spans more than six decades It is common or abundant on north-facing slopes above Bull Pasture and probably elsewhere in similar situations in the Ajos, where it is usually found with the wild tepary, *Phaseolus acutifolius*

Tucson amaranth is seldom common and is known from only a few widely scattered localities in southern Arizona (near Tucson and in Organ Pipe) and in southeastern Sonora (Henrickson 1999) This enigmatic amaranth may be of hybrid origin as proposed by Henrickson (1999) or if not a stabilized hybrid then perhaps a variety of *A. retroflexus* Linnaeus (Costea et al 2001, also see Mosyakin & Robertson 2003)

The plants might be confused with *A. albus* or *A. palmeri* The 5 female sepals and 5 rather than 3 stamens readily distinguish *A. ×tucsonensis* from *A. albus* *Amaranthus ×tucsonensis* is distinguished from *A. palmeri* by its shorter, non-spinescent bracts and non-spiny female sepals, shape of the female sepals, roughened fruit "cap" or "lid," and the continuous terminal inflorescence is not drooping as in *A. palmeri*

OP Alamo Canyon, 13 Dec 1939, *Harbison 26249* Bull Pasture, *Wirt 29 Oct 1989* Arch Canyon, N-facing slope below the arch, 900 m, 2 Dec 1990, *Felger 90-560* Above Bull Pasture, trail to Mt. Ajo, 1030 m, 22 Oct 2006, *Rutman 20061022-13*

Figure 17 *Amaranthus ×tucsonensis*. Bull Pasture Trail above Bull Pasture, 22 Oct 2006

††?**Amaranthus** sp. spp.

Several fossil collections may represent more than one species.

OP Alamo Canyon, fruit, 1150 ybp Montezuma's Head, fruits, 13,500 & 20,490 ybp [The 13,500 ybp specimen may be *A.* × *tucsonensis*] Puerto Blanco Mts, seeds, 980 & 990 ybp

TA Tinajas Altas, seeds, 9900 & 10,600 ybp

Atriplex Saltbush

Annuals to woody shrubs. The plants scurfy gray or whitish due to inflated hairs that collapse upon drying. Leaves mostly alternate, the lowermost ones sometimes opposite. Flowers unisexual; male and female flowers on the same or separate plants. Female flowers and fruits enclosed in a pair of sepal-like bracts; as the fruits develop the bracts enlarge, thicken, and often grow various ornamentations such as wings and crests.

Seeds of some *Atriplex* species were parched or cooked with other foods but generally served as emergency food (Hodgson 2001). Young plants of herbaceous species or young shoots of shrubs were cooked as greens or with other foods for the salty flavor (Rea 1997).

1. Annuals; male and female flowers on the same plant.

    2. Fruiting bracts disk-shaped (orbicular), evenly toothed all around the margin... **Atriplex elegans**
    2. Fruiting bracts widest above middle, more or less truncate with coarse teeth arising above the middle. ..... **Atriplex pacifica**

1. Woody shrubs; male and female flowers on separate plants (except *A. lentiformis*)

    3. Fruiting bracts 4-winged (4 wing-like margins).

        4. Larger shrubs, commonly 1 m or more in tall; larger leaves often more than 3 cm long, 4–6 (8) mm wide; mature fruits with bracts often 1–2 cm long. ..... **Atriplex canescens**
        4. Smaller shrubs, commonly 1 m or less in height; larger leaves often 1–3 (4+) cm long, 2–4 mm wide; mature fruits with bracts often 0.4–0.5 (0.8) cm long. ..... **Atriplex linearis**

    3. Fruiting bracts not winged, the margins toothed or not.

        5. Bracts not toothed, or the teeth shallow and much broader than long; leaves mostly more than three cm long, the petioles well developed; male and female flowers on the same plant ..... **Atriplex lentiformis**
        5. Bracts conspicuously toothed, teeth 7 or more and mostly longer than wide; leaves mostly less than 2 cm long, sessile to subsessile; male and female flowers on separate plants. ..... **Atriplex polycarpa**

Atriplex canescens (Pursh) Nuttall

Four-wing saltbush; *chamizo cenizo*; 'onk 'i:vakĭ. Figure 18.

Shrubs to 2 m tall with scurfy gray-green herbage, tardily drought deciduous. Flowering in spring and summer. Leaves scurfy gray-green, entire, narrowly spatulate to narrowly oblong, larger leaves reaching 3 4.5 (5) × (0.2) 0.4–0.8 cm. Male and female flowers on separate plants. Fruiting bracts conspicuously 4-winged, often 1 2 cm diameter.

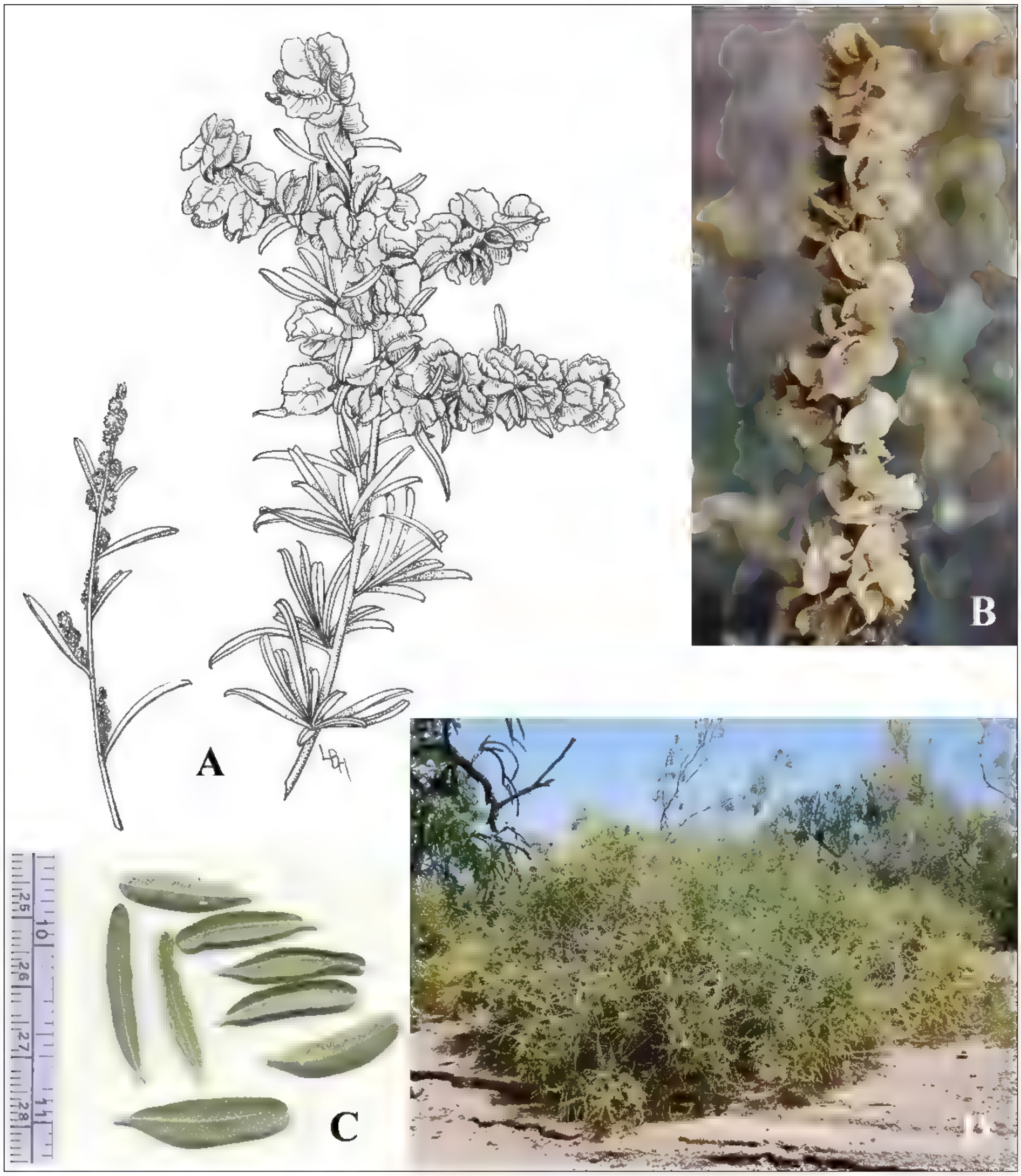

Figure 18 *Atriplex canescens* subsp *canescens* (A) Staminate (left) and pistillate branches, (B) fruiting bracts, Estes Canyon, 20 Jan 2014, (C) Kuakatch Wash near Hwy 85, 29 Jan 2014, (D) Kuakatch Wash near Hwy 85, 23 May 2010

Wash margins and xeroriparian areas of valley bottoms and sometimes on rocky slopes to high elevations. It grew in the Ajo Mountains 9600 years ago.

A polymorphic species; western North America and northern Mexico.

Tea made from the leaves was taken as an emetic by the Seris (Felger & Moser 1985). Livestock favor this species due to its high protein content. Populations on Organ Pipe are probably still recovering since livestock were removed in the late 1970s.

OP Tres Alamos Canyon, *Nichol 24 Feb 1939* Wash NE of Pinkley Peak, 32 Oct 2003, *Rutman 20031031-1* (ORPI) †Alamo Canyon, leaves, fruit, 9570 ybp
CP Pinta Sands, *Simmons 17 Oct 1962* (CAB) Little Tule Tank, *Simmons 19 May 1963* Packrat Hill, 25 Feb 1993, *Felger 93-61* Charlie Bell Rd, 1 km W of Refuge boundary, 5 Mar 1994, *Felger 94-24*

††Atriplex confertifolia (Torrey & Frémont) S. Watson
Shadscale

Low, subshrubs. Shadscale occurred in Ice Age woodlands in the Ajo Mountains but seems to have been fairly scarce. Today it is a dominant element in the Great Basin Desert in saline valley bottoms above the Mogollon Rim. The nearest present-day population is in the vicinity of Safford and Thatcher in Graham County, Arizona, near the margin of the Sonoran Desert.

Oregon and California to North Dakota and Chihuahua.

OP Montezuma's Head, leaves, fruit, 13,500 & 21,840 ybp.

Atriplex elegans (Moquin-Tandon) D. Dietrich
[*A. elegans* subsp. *fasciculata* (S. Watson) H.M. Hall & Clements. *A. fasciculata* S. Watson]
Wheelscale orach; *chamizo cenizo*; 'onk 'i:vakĭ. Figure 19.

Annuals or short-lived perennials, with scurfy gray-green herbage, maturing from May through October. Leaves 0.8 3 (4.7) cm long, mostly oblong to oblanceolate. Male and female flowers on the same plant. Fruiting bracts disk- or wheel-shaped (as reflected in the English common name), 2.4–5 mm wide, compressed, orbicular, the margins crenulate to toothed throughout, the teeth small to large and coarse.

Gravelly, sandy soils of dry riverbeds and larger washes and floodplains, and margins of larger playas, often on alkaline saline soils, and disturbed, weedy habitats including roadsides. Widely scattered localities in the flora area and in the Ajo Mountains 9600 years ago. The young plants were eaten as greens or used as seasoning by the Gila River Pimas (Rea 1997; Russell 1908).

Widespread in Arizona; southeastern California to western Texas, Baja California, and Sonora to Chihuahua and Durango.

The two subspecies are of doubtful significance and often grow intermixed, such as at Alamo Canyon and Quitobaquito (Felger 2000). Subsp. *elegans* is characterized by having thinner leaves, the lower leaves with wavy and often toothed margins, the upper leaves often entire, and the fruiting bracts coarsely toothed. Subsp. *fasciculata* is characterized by having generally thicker leaves with entire margins, and crenulate to shallowly small-toothed fruiting bracts. Younger and more robust plants tend to resemble subsp. *fasciculata*, whereas older and perhaps more water-stressed plants tend to key to subsp. *elegans*. The variation seems continuous, apparently sometimes changing between early- and late-season growths. The subspecies show some geographic segregation but with a very broad region of overlap. Subsp. *elegans* reported for Durango, Chihuahua, and western Texas to

Arizona, southeastern California, and northern Sonora southward to the vicinity of Guaymas. Subsp. *fasciculata* known from southern California, northern Baja California, northwestern Sonora, and southern Arizona.

OP Quitobaquito *Nichol 28 Apr 1939*, 23 Jul 1986, *Felger 86-207* Ajo Mt Drive, 2000 ft, 5 Nov 1977, *Bowers 912* Alamo Canyon, *Van Devender 31 Aug 1978* (ORPI) NNW of Lukeville, *Rutman 14 Mar 1995* (ORPI) Armenta Ranch, old fields, 1 Feb 2002, *Felger 02-74* †Alamo Canyon, fruits, 9570 ybp.
CP Tule Well, 13 Apr 1992, *Harlan 253* (CAB) Dos Playas, 13 Jun 1992, *Felger 92-581*

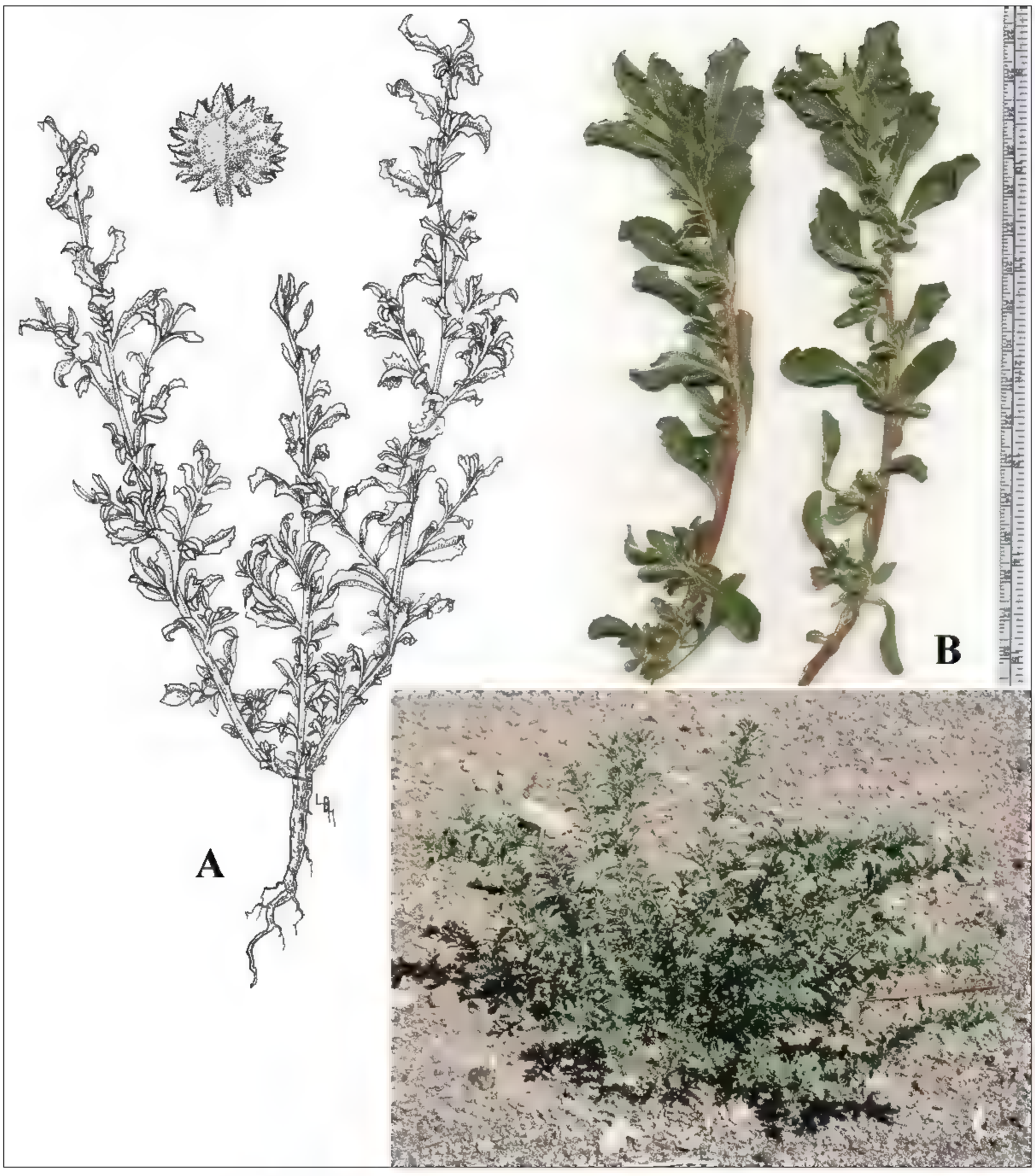

Figure 19 *Atriplex elegans* (A) Plant and fruiting bracts, (B) international boundary near El Huerfano, 5 Mar 2014, (C) Ajo, 6 May 2006

Atriplex lentiformis (Torrey) S. Watson subsp. **lentiformis**
Quail bush, lens scale, big saltbush; *chamizo grande*. Figure 20.

Mound-shaped shrubs often 2 2.5 m tall. Leaves 3 5 × (1.5) 2 4 cm; petioles well developed, the blades triangular, triangular-hastate, rhombic, ovate, or oblong, grayish blue, and relatively thin. This species can have male and female flowers on the same or separate plants. Fruiting bracts (2) 3 3.5 mm wide, often lens-shaped, sometimes longer than wide, flattened with shallow, blunt teeth, and not winged. Flowering and fruiting in spring and summer-fall. This species is distinguished from other Sonoran Desert saltbushes by its large size, and large, broad, and relatively thin leaf blades and well-developed petioles.

Formerly present in low-lying alkaline soils near the pond at Quitobaquito and on low hills near the spring. By 1999 there were only two plants on the eastern spring slope and none were seen in 2012. It is common along the Río Sonoyta in nearby adjacent Sonora (Felger 2000).

Deserts in western Arizona, California, Nevada, Utah, Baja California, and northwestern Sonora. Another subspecies occurs from the Mojave Desert in California to Utah.

OP Quitobaquito *Nichol 28 Apr 1939*, *Rutman 23 Apr 1999* (ORPI).

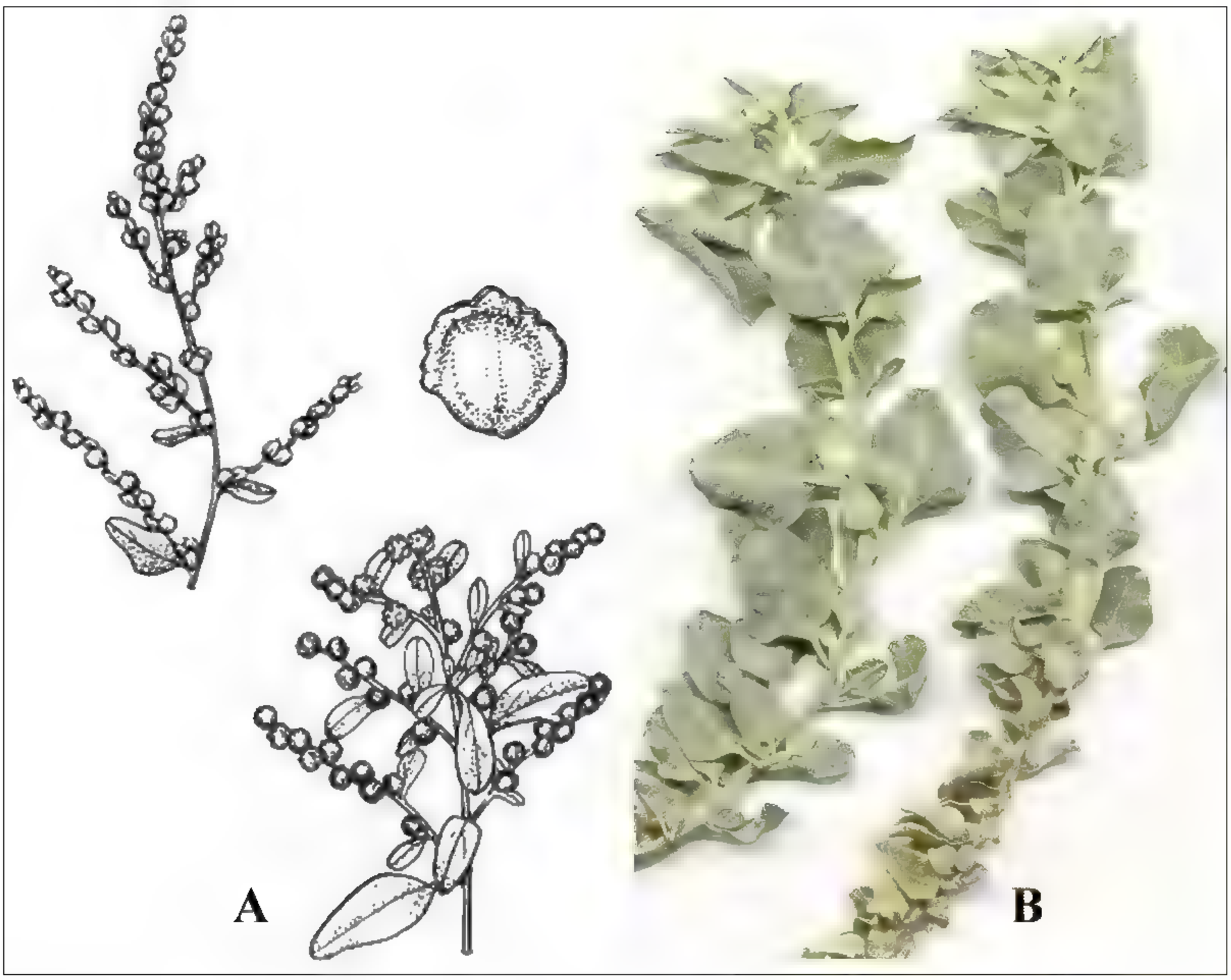

Figure 20 *Atriplex lentiformis* subsp *lentiformis* (A) Staminate (lower) and pistillate (upper) branches and fruiting bracts, (B) Gila River near Hwy 85, 4 Apr 2002

Atriplex linearis S. Watson
[*A. canescens* (Pursh) Nuttall subsp. *linearis* (S. Watson) H.M. Hall & Clements]
Narrowleaf saltbush. Figure 21.

Small shrubs with upright stems. Leaves linear to narrowly oblong and keeled, the larger leaves often 1–3 (4+) cm × 2–4 mm. Male and female flowers on separate plants; reproductive mostly spring and summer. Fruiting bracts narrowly 4-winged. *A. linearis* distinguished from *A. canescens* and by overall smaller size, smaller and narrower leaves, smaller fruits, and often more pronounced (more deeply laciniate) teeth on the bracts.

Figure 21 *Atriplex linearis* (A) Pistillate branch, MEX Hwy 2, international boundary E of Quitobaquito, 5 Oct 2013, (B & C) International boundary near El Huerfano, Sonora, 6 Feb 2014 fruiting branches

Locally common on alkaline flats or semi-alkaline soils of lower bajadas, floodplains, and playa margins. Often growing with *A. polycarpa* and apparently more salt-tolerant than *A. polycarpa* and less salt-tolerant than *Suaeda nigra*.

Southeastern California, both Baja California states, southwestern Arizona, and coastal Sonora south to the Río Mayo delta and perhaps northwestern Sinaloa.

Often treated as a subspecies of *A. canescens* or sometimes regarded as distinct species (e.g., Felger 2000). They are geographically sympatric but occupy different habitats in many places in the Sonoran Desert, from at least near Phoenix, Arizona, to the Guaymas region in Sonora. Plants of intermediate character have not been seen in those places.

OP Quitobaquito *Nichol 10 Mar 1939* (ORPI), 24 Oct 1990, *Felger 90-488* Dos Lomitas, *Warren 17 Nov 1974* Cipriano Well, *Rutman 30 Aug 2001* (ORPI)
CP Las Playas, 31 Jan 1992, *Felger* (observation)

Atriplex pacifica A. Nelson
Pacific orach. Figure 22.

Winter-spring to early summer annuals as small as 5 cm tall and upright to spreading and 40 cm across; often semi-succulent, densely short-branched, forming tangled masses. Leaves elliptic, obovate, or oblanceolate, uniformly scurfy gray on both surfaces, mostly 7 20 mm long, the margins mostly entire; lower leaves sometimes petioled. Male and female flowers on the same plant. Fruiting bracts (1) 1.2 1.5 mm wide, mealy, mostly obovoid, truncate at tip, cuneate at base, with 3 or 5 apical teeth; bracts usually with a keel or ridge and a tubercle or spine often on each side of the ridge.

Roadsides, natural desert pavements, bajadas, and arroyo or washes, and partially barren flats. In Arizona localized along the eastern and southern margins of Cabeza Prieta and in Organ Pipe near the Mexico border west of Lukeville.

Also western Sonora southward near the coast between Puerto Libertad and El Desemboque San Ignacio, and widespread and common in coastal areas of the Pacific side of the Baja California Peninsula and southern California, where the plants are often robust and 30 100 cm wide.

The distribution in Arizona and Sonora is patchy, the plants tend to be small, and the populations tend to be small and localized, which hints at colonization by individual plants. The earliest collection from Arizona or Sonora is 1966. It might be a relatively recent introduction from the Pacific coast where it is much more widespread (Felger 2000).

OP Puerto Blanco Drive, 2-way section ca 10 mi W of Hwy 85, 11 Apr 1978, *Bowers 1225*, 7 mi W of Hwy 85, 10 May 1979, *Bowers 1721*.
CP 6 mi E of Papago Well on Camino del Diablo, 13 Apr 1983, *Eiber 7* San Cristobal Wash, 20 Mar 1992, *Harlan 40*

Atriplex polycarpa (Torrey) S. Watson
Desert saltbush, allscale saltbush; *chamizo cenizo*; 'onk 'i:vakĭ. Figures 23.

Woody shrubs, often long-lived, much branched with slender twigs, gradually becoming leafless or nearly so during extended drought. Leaves highly variable and small, the larger ones 5 20 mm long, gray-green to whitish, elliptic to spatulate; dry-season and short-shoot leaves seldom more than 10 mm long. Male and female flowers on separate plants. Flowering in various seasons, especially with hot weather following rains. Fruiting bracts usually 4–6 mm wide, somewhat orbicular to obdeltoid, often with 7–17 finger-like blunt teeth, varying in size and shape and often obscured by dense scurfy white hairs. Fruits strongly malodorous. Often with characteristic pink galls in the upper branches and inflorescences.

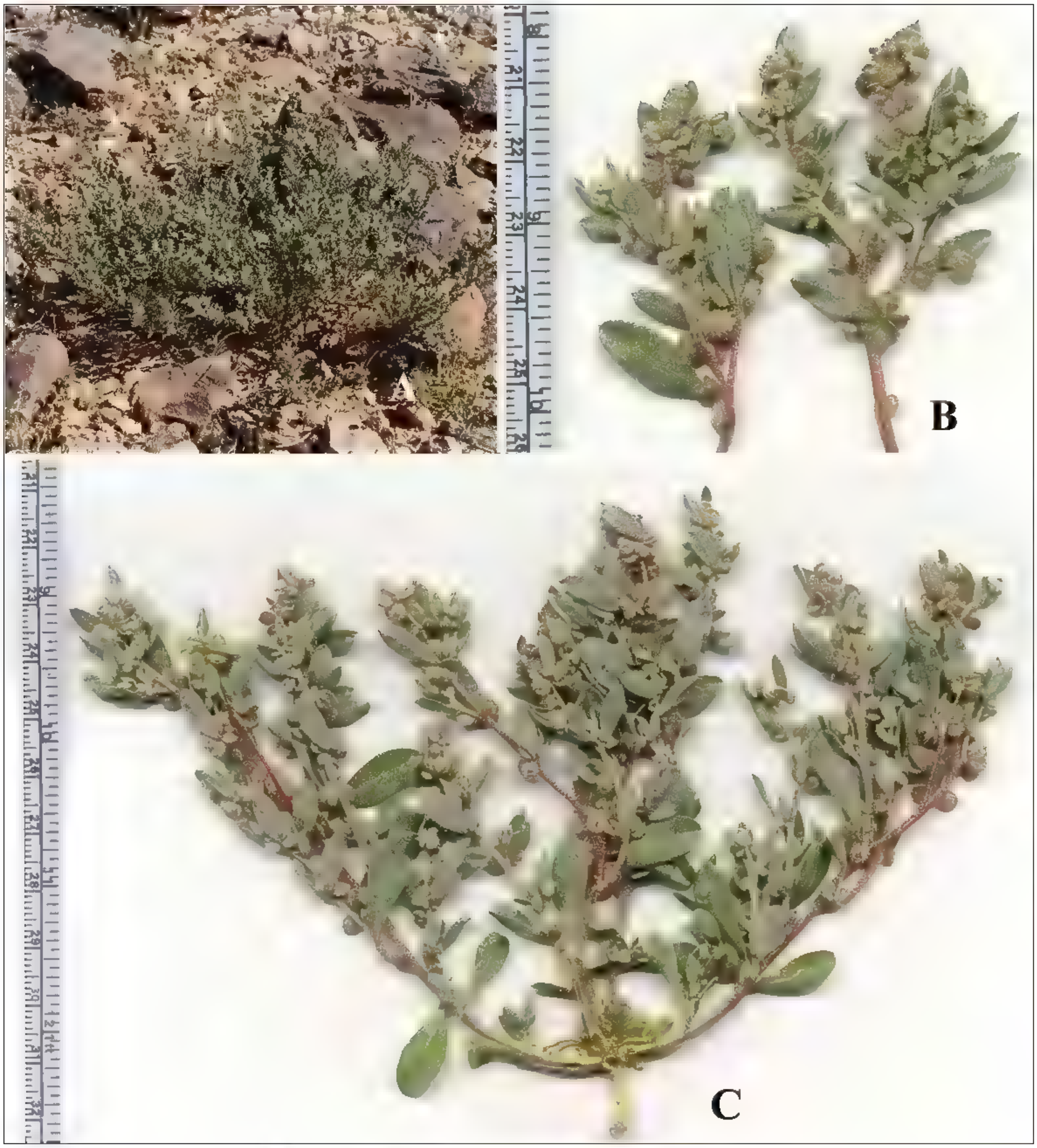

Figure 22 *Atriplex pacifica* (A) Low hills surrounded by dunes, 20 mi S of Sonoyta on MEX Hwy 8, Sonora, 20 Feb 2014, (B & C) roadside of Mexico Hwy 2 near El Huerfano, Sonora, 5 Mar 2014

Locally common on a surprising variety of habitats, especially alkaline or saline soils or bedrock, sandy to rocky soils of desert plains, washes, and slopes to peak elevations on the drier mountains Often on tuff bedrock, with hop bush (*Dodonaea*) usually an associate, and creosotebush (*Larrea*) and narrowleaf saltbush (*Atriplex linearis*) absent for example, a patch of this vegetation is at the saddle between Boulder and Arch Canyon in the Ajo Mountains

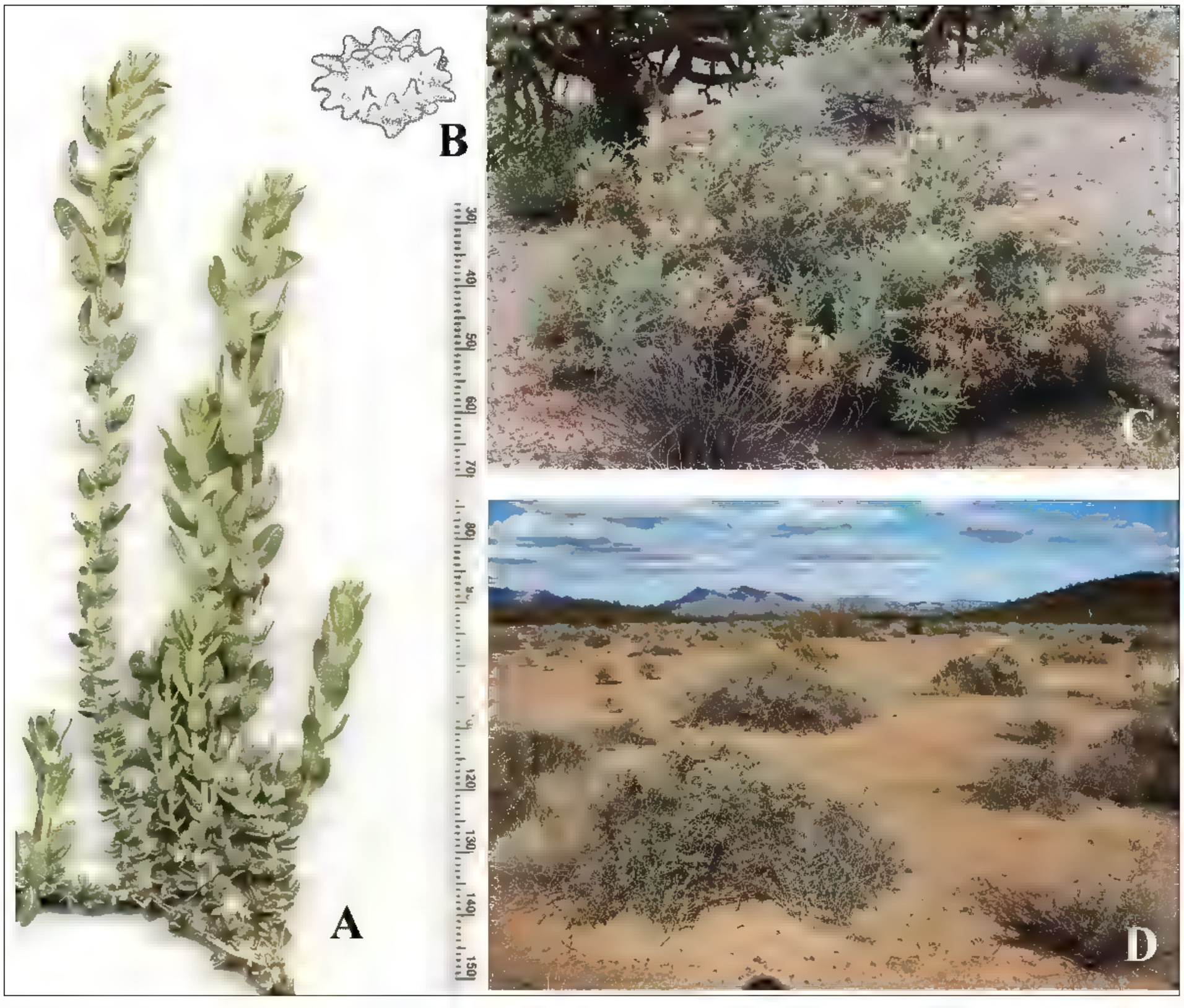

Figure 23 *Atriplex polycarpa* (A) Near Dos Lomitas, 28 Feb 2008, (B) fruiting bracts, (C) floodplain of Rio Sonoyta near Agua Dulce west of Sonoyta, Sonora, 6 Feb 2014, (D) Dos Lomitas, 25 Jan 2008

Packrat midden samples from the Ajo Mountains that are probably this species date from more than 29,000 years ago

Deserts in southern and western Arizona, Nevada, southern California, the Baja California Peninsula, and western Sonora

The seeds were eaten (Castetter & Bell 1951) and perhaps used as a famine food by the Hohokam around Phoenix (Bohrer 1985 in Hodgson 2001) An infusion of mashed young shoots was used by the Seris as shampoo and laundry detergent (Felger & Moser 1985)

OP Quitobaquito *Nichol 10 Mar 1939*; 23 Oct 1987, *Felger 87-268* W of Gachado Line Camp, *Wirt 20 Mar 1989* (ORPI) Vicinity of Cipriano Well, *Rutman 30 Aug 2001* (ORPI) †Probably *A. polycarpa* Alamo Canyon, leaves, fruits, 1150 to 29,110 ybp (3 samples), Montezuma's Head, leaves, fruits, 20,490 ybp

CP 1 2 miles NW of Tule Well Camp, *Van Devender 9 Mar 1980* Charlie Bell Well, 26 Sep 1992, *Harlan 311* (CAB) Observations Tule Tank, 2 Feb 1992, *Felger*, Buckhorn Tank, Papago Well, Tuseral Tank, 12 14 Jun 1992, *Felger*

TA Camino del Diablo, E of Raven Butte, 10 Jan 2002, *Felger 02-04* SW side of Tinajas Altas Mts, flats and granitic hills, 10 Jan 2002, *Felger* (observation) †Butler Mts, leaves, 10,360 ybp

****Atriplex wrightii** S. Watson.

Bushy annuals, often germinating in winter-spring and maturing early summer to fall. Monoecious. Fruiting bracts more or less obdeltoid, with 5 or 7 terminal teeth.

Not known from the flora area but documented just south of the Organ Pipe in the vicinity of Sonoyta and probably not native to that region, as it occurs only in disturbed habitats. Western Texas to central and southern Arizona and northern Sonora.

Sonora Sonoyta, 4 Oct 1985, *Felger 85-928*.

Figure 24 *Bassia hyssopifolia* (A) Plant, fruiting calyx, seeds, and portion of spike, (B) construction area, Hwy 85 at Cherioni Wash crossing, 13 Apr 2005

****Bassia hyssopifolia** (Pallas) Kuntze
Smother weed. Figure 24.

Leafy annuals with a well-developed main stem, usually germinating in spring and maturing in fall. The hooked spine at the end of each of the 5 calyx lobes is unique among the plants of this flora.

The two specimen records for Organ Pipe grew from seeds in straw imported from California and used to control erosion at construction sites. It is abundant primarily as an agricultural weed around Sonoyta adjacent to the southern margin of the monument and can be expected to spread into the monument on the heels of disturbance.

Native to Eurasia; widespread weed in western North America since its reported introduction in Nevada around 1915.

OP Hwy 85, roadside at Cherioni Wash, ca. 4.7 mi N of Park headquarters, *Rutman 15 Apr 2005* (ORPI)

Figure 25. *Chenopodiastrum murale*. (A) Flowering plant with fruiting calyx and seed, (B) international boundary near El Huerfano, Sonora, 5 Mar 2014.

***Chenopodiastrum murale** (Linnaeus) S. Fuentes, Uotila & Borsch
[*Chenopodium murale* Linnaeus]
Netleaf goosefoot; *chual, choal*; 'onk 'i:vakĭ, kaupdam. Figure 25.

Winter-spring annuals, sometime persisting into summer in well-watered, shaded habitats. Herbage green or often reddish green, sometimes semi-succulent. Leaves alternate, glabrous or sometimes gray scurfy below, often 3–10 cm long, the blades mostly ovate to rhombic, irregularly toothed, the petioles well developed. Flowers bisexual. Sepals often keeled, mostly partially spreading at maturity to reveal part of the seed. Seeds 1.2–1.4 mm wide, lens-shaped, blackish, mostly devoid of dried pericarp, dull even after removal of pericarp, the margins acute with a thin rim.

Widespread; washes, canyon bottoms, damp soil at tinajas and waterholes, dirt tanks, and especially at improved waterholes and disturbed habitats.

Reported as not native in the New World, although long established and widespread in the Sonoran Desert with a long history of use in the region. Young plants were eaten as greens (Castetter & Bell 1951; Castetter & Underhill 1935). The seeds were toasted and ground into flour, and are apparently the only edible seeds in the region that open like popcorn when heated (Felger 2007; Felger & Moser 1985).

Fuentes et al. (2012) separated five former species of *Chenopodium* as *Chenopodiastrum* to form a monophyletic genus occurring in Africa, Eurasia, and North America.

OP Quitobaquito *Nichol 28 Apr 1939*, 13 Sep 1988, *Felger 86-269* Gachado Line Camp, 27 Jan 1978, *Bowers 1015*

CP Tule Tank, 2 Feb 1992, *Felger 92-65* Jose Juan Tank, 26 Feb 1993, *Felger 93-106* Charlie Bell Well, 10 Apr 1993, *Felger 93-366*

TA Tinajas Altas, 19 Mar 1998, *Felger 98-149*.

Chenopodium cf. **watsonii** A. Nelson
Watson's goosefoot. Figure 26.

Winter-spring annuals. Leaves alternate and petioled. Herbage often pale grayish green, and mealy with inflated whitish hairs. The entire plant is very stinky, even when young—some say it smells like rotten fish. Flowers bisexual. Seeds lens-shaped, ca. 1 mm wide, the surfaces covered by a translucent pericarp forming a minute cellular pattern (like minute honeycomb depressions), the seeds shiny blackish after removal of this covering, the margins obtuse (without a distinct rim).

Apparently all the stinky chenopodiums in the region are this species, characterized by odor, leaf shape (variable but often more or less rhomboid) and color (pale and mealy on both surfaces), and mature calyx covering the seed. The pericarp (the thin seed covering) is distinctly white-waxy; sometimes, however, even mature fruits may lack the distinctive full white pericarp although there will be some whitish cells, so the pericarp, while waxy, is mostly black and only partly whitish.

Widely scattered, in small to large populations but seldom abundant; generally on rocky slopes and canyons in the Ajo and Puerto Blanco Mountains.

Alberta and Saskatchewan to southern Arizona and New Mexico, and undoubtedly adjacent northern Sonora and Chihuahua.

The name goosefoot derives from the leaf shape of certain species. *Chenopodium*, with about 150 species, is worldwide.

OP Dripping Springs, 29 Jan 1978, *Bowers 1019* (ORPI) Alamo Canyon, *Van Devender* 31 Aug 1978 (ORPI) Trail from The Cones to Mount Ajo, 4090 ft, 10 Apr 2005, *Felger* (observation)
Puerto Blanco Mts, Dripping Wells, 2600 ft, rocky NE slope, herbage with fetid odor, 18 Mar 1945, *Gould 3016* (as *C. fremontii* S Watson, det H A Wahl 1966)

Figure 26. *Chenopodium* cf. *watsonii*. Alamo Wash: (A) 30 Jul 2013; (C) 11 Mar 2014. (B) S of Animas in Hidalgo Co., New Mexico, 19 Aug 2010, photo by Patrick Alexander (SEINet).

††?**Froelichia** sp.

There is a fossil specimen 13,500 years old from the Ajo Mountains. It is likely to be *F. arizonica* Thornber ex Standley, an herbaceous perennial, often short-lived and mostly growing and flowering with summer rains. The flowers are inconspicuous and nearly hidden in woolly bracts.

The nearest present-day population is in the Baboquivari Mountains. It ranges from southern Arizona to west Texas and Sonora to Coahuila and Nuevo León.

The fossil is less likely to be *F. gracilis* (Hooker) Moquin-Tandon, an annual with the nearest populations in central and southeastern Arizona, and ranges from eastern and central United States to northern Mexico.

OP: Montezuma's Head, achene, 13,500 ybp.

Gomphrena sonorae Torrey

Sonoran globe amaranth. Figure 27.

Annuals or short-lived herbaceous perennials; mostly responding to summer-fall rains, and sometimes weakly re-growing with winter-spring rains; usually few-branched and taller than wide. Leaves mostly basal, green, elliptic to oblanceolate or linear, often 3–10 cm long, sessile or short-

Figure 27 *Gomphrena sonorae* (A & C) Garden Canyon, Huachuca Mts, photo by Liz Makings (SEINet), (B) Patagonia Mts area, Cochise Co., 17 Aug 2011, photo by Eugene Sturla (SEINet)

petioled. Flowers 3 5 4 mm long, crowded in rounded clusters among papery white bracts and nearly hidden among cottony white hairs Sepals separate, rather papery and not firm, the tips acute

In the flora area known only from Bull Pasture in the Ajo Mountains Sue Rutman has tried, to no avail, to find this plant again in the Ajo Mountains

Arizona and southwestern New Mexico to western Mexico including the Baja California Peninsula

OP Bull Pasture 3300 ft, *Henry probably 1977 or 1978* (ORPI), Wash, *Wirt 13 Nov 1989* (ORPI)

Monolepis nuttalliana (Schultes) Greene
Poverty weed, ʾopoñ Figure 28

Low-growing winter-spring annuals, plants semi-succulent, spreading to semi-prostrate with age and size, the stems often 5–25 cm long Larger leaves mostly 1–5 cm long, the petioles expanding into lanceolate to linear blades with hastate "ears," the smaller leaves often entire, leaves reduced upwards to leafy bracts Flowers unisexual or bisexual, in dense, sessile, axillary clusters, flowers minute and inconspicuous, floral parts greatly reduced, the calyx usually of 1 persistent green sepal, the stamens 1 (2) or none Seeds 0.9–1.2 mm wide, flattened, lens-shaped, dull beneath a thin, persistent pericarp with a honeycomb-alveolate pattern

Sandy gravelly and silt-clayish soils of washes, canyon bottoms, and dirt tanks Widely scattered in the northern and eastern part of Organ Pipe and known by one record from Cabeza Prieta

Alaska and Canada to northern Mexico and in Argentina, adventive in the Old World Desert populations in western North America have much narrower and smaller leaves than those from more humid, temperate regions *Monolepis* might be confused with *Cistanthe monandra* (Portulacaceae), which has entire leaves and multiple-seeded fruits

This spring annual was widely used as greens Betty Melvin mentions a "wild spinach they eat [called] *opon*" (Zepeda 1985: 73) The seeds are also edible (Hodgson 2001)

OP Tres Alamo Canyon, 2700 ft, *Nichol 24 Feb 1939* Sandy flats near old ranch by Kuakatch Wash at N boundary [Armenta], 30 Mar 1978, *Bowers 1160* Mouth of Alamo Canyon, *Rutman 15 Mar 2003* (ORPI)
CP Redtail Tank in silty-clayish soil next to the represo, locally abundant, 25 Feb 1993, *Felger 93-77*

Figure 28 *Monolepis nuttalliana* Vicinity of Lost City, San Cristobal Valley, Cabeza Prieta, 13 Mar 2014

Nitrophila occidentalis (Moquin-Tandon) S. Watson
Alkali weed. Figure 29.

Highly succulent herbaceous perennials from deep, thick succulent rhizomes to 2.5 cm in diameter and 15+ cm deep; above-ground parts are freeze-killed with frost, new shoots rapidly appear in early spring. Stems much-branched. Leaves sessile, succulent and linear, mostly 1–2.5 cm long, the lower leaves clasping the stems. Flowers bisexual, 1 or 3 in leaf axils, subtended by 2 leaf-like bracts of unequal size. Calyx lobes and stamens 5, the calyx 2.5–4 mm long, fleshy, green outside, pink within, persistent when dry with a midrib keel. Seeds 1.4–1.5 × 1.2 mm, D-shaped, smooth and shining, dark red-brown to blackish. Flowering at least March and April.

Figure 29 *Nitrophila occidentalis* Quitobaquito (A) 19 Mar 2008, (B & C) 5 May 2005

Locally common in alkaline saline wet soils at Quitobaquito. Deer paw the ground to expose and eat the rhizomes and shoots.

Saline alkaline wetlands in southwestern Arizona, northwestern Sonora, and northeastern Baja California to Oregon and Nevada

OP Quitobaquito *Nichol 28 Apr 1939*, between Quitobaquito and Burro Spring, with *Suaeda torreyana*, *Haplopappus acradenius*, 14 Jun 1978, *Bowers 1333*, Hypersaline soils wetted by Quitobaquito Springs, to the NE of Quitobaquito Pond, with *Juncus mexicanus*, *Eleocharis rostellata*, 15 June 2013, *Rutman 20130615-2*

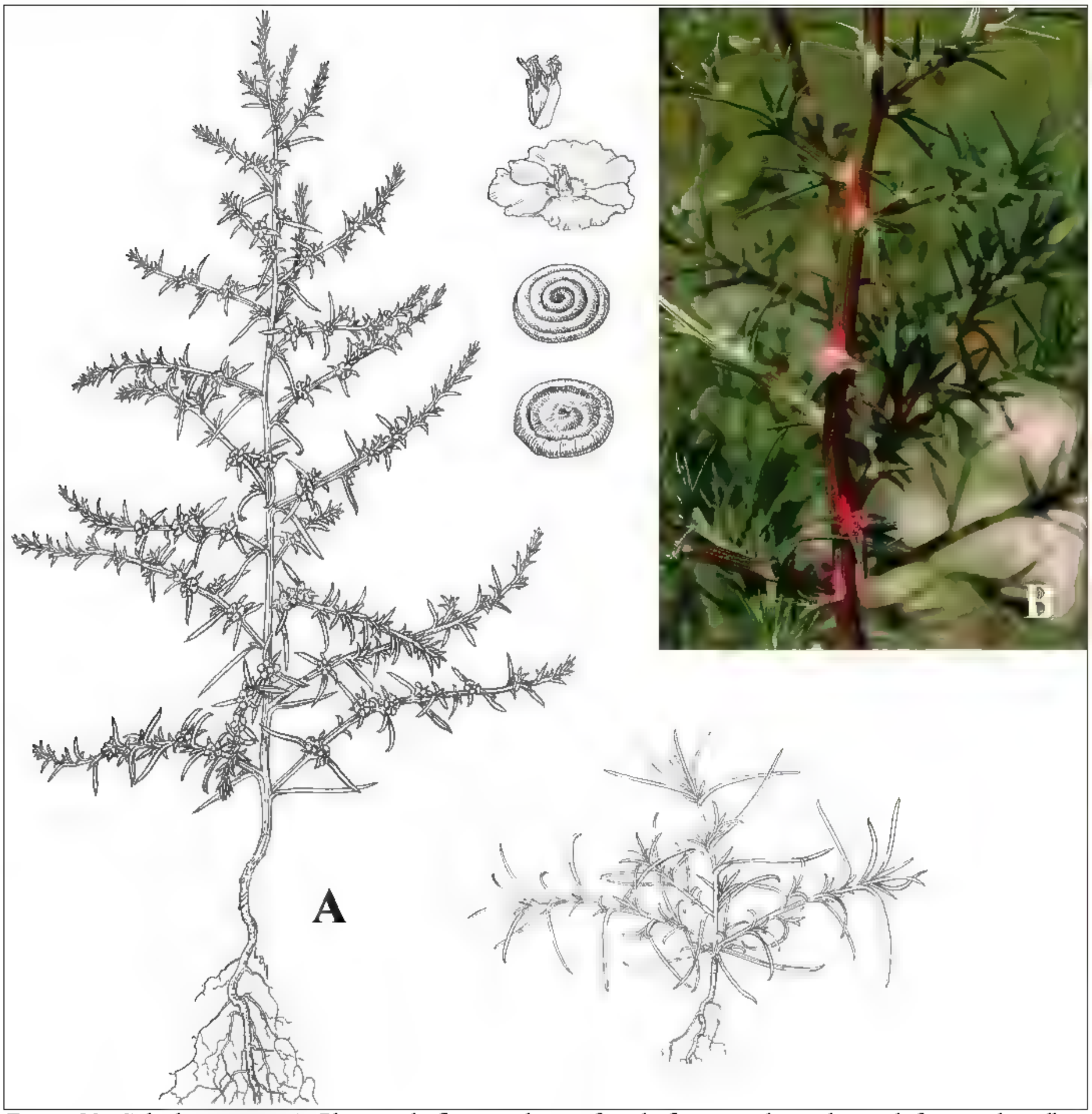

Figure 30 *Salsola tragus* (A) Plant, male flower (above), female flower with sepals, seed, fruit, and seedling, (B) Ajo, 26 Feb 2005

***Salsola tragus** Linnaeus
[*S. australis* R. Brown. *S. iberica* (Sennen & Pau) Botschantzev ex Czerepanov. *S. kali* of authors, not *S. kali* Linnaeus. *S. kali* var. *tenuifolia* Tausch ex Moquin-Tandon. *S. pestifer* Nelson]
Russian thistle, tumbleweed, *chamizo volador*, hejel ʼeʼesadam, vo poʼodam saʼi. Figure 30

Warm weather annuals, germinating in spring or with the summer rains, plants globose at maturity at the end of summer or fall, breaking off at ground level to become tumbleweeds. Lower or seedling leaves often linear to thread-like, semi-succulent; upper leaves 1–2.5 cm long and spinescent-tipped. Flowers bisexual, in upper leaf axils, subtended by ovate, spinescent bracts 5–8 mm. Fruiting calyx pink to white, with collar-like wings often 5–6.5 mm wide. Seeds fall with the calyx.

Disturbed habitats, mostly roadsides and along washes. Populations decline over time as sites recover from disturbance. A fire east of Dos Lomitas in 2000 (Martin Fire) was carried by tumbleweeds that had piled up against the boundary fence and spilled into Organ Pipe. People on the Mexican side of the border were burning "weeds" in farm ditches and the fire got out of control.

This C4 plant is native to Eurasia and has become a troublesome weed worldwide, especially on disturbed soils in hot, dry regions.

OP Puerto Blanco Drive, 10 mi W of Hwy 85, 10 May 1979, *Bowers 1720.*
CP Childs Mt *Simmons 30 Oct 1963* (CAB) 2300 ft, 18 Aug 1992, *Felger 92-644*

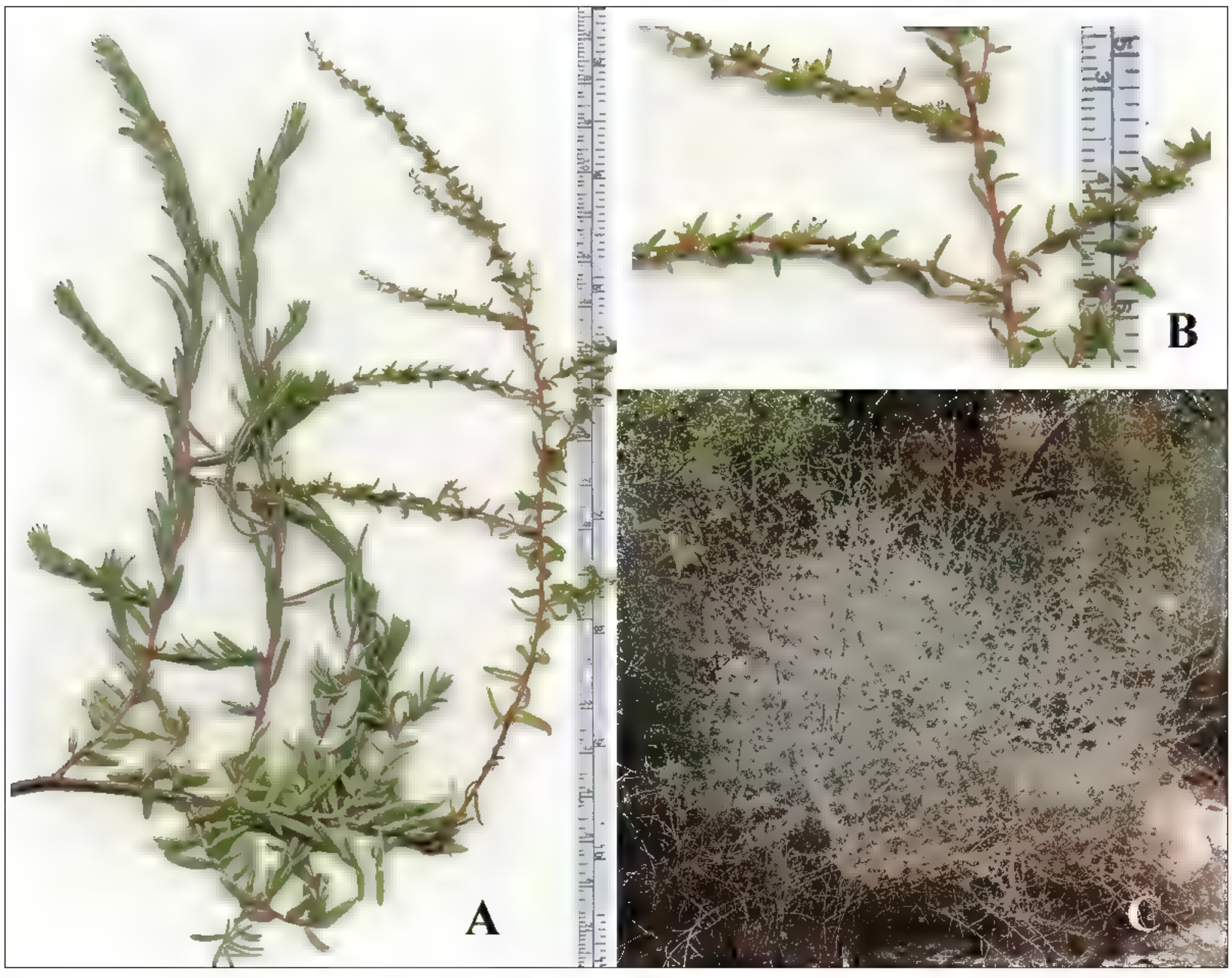

Figure 31 *Suaeda nigra* Quitobaquito (A & B) 11 Sep 2008, (C) 22 Jun 2006

Suaeda nigra (Rafinesque) J.F. Macbride
[*S. moquinii* (Torrey) Greene. *S. torreyana* S. Watson]
Seepweed; *quelite salado*; s-cuk onk. Figure 31.

Densely-branched, mound-shaped succulent shrubs often 1–2 m tall, branched throughout with many spreading, interlacing branches; foul smelling when crushed. Stems slender and brittle. Herbage green to glaucous blue-green and often reddish purple. Leaves alternate and succulent, the long-shoot leaves linear, often 10–30 mm long, the short-shoot leaves usually crowded, 3–8 mm long and bead-like. Flowers minute, mostly produced during the warmer months. Flowering branches slender and paniculate. Flowers 1 ca. 10 per cluster, often functionally unisexual. Sepals 5, succulent and hooded, unequal in size in female flowers, the fruiting calyx bilateral, often 1.3–1.6 mm wide. Seeds 1–1.5 mm diameter.

Locally common on saline or alkaline soils. Washes and near springs and waterholes in the southwestern margin of Organ Pipe from the vicinity of Ten Mile Hill to the southwestern corner (see *Wislizenia refracta*) and the vicinity of Dos Lomitas. Cabeza Prieta along the large xeroriparian washes at Tule Well and on temporarily wet soil near Papago Well.

Alberta and the western United States to northern and central Mexico.

Seepweed was cooked by Gila River Pimas as greens, used for flavoring in cooking other foods, or added to cactus fruit for flavor. It was also used to line a pit for baking cholla buds of *Cylindropuntia acanthocarpa* (Curtin 1949; Rea 1997; Russell 1908). Young tender plants of this or a similar species, called *romerillo*, are a well-known vegetable in southern Mexican cuisine.

OP Quitobaquito, *Nichol 3 Mar 1939* Williams Spring, *Van Devender 30 Aug 1978* 3.5 mi E of Aguajita, 24 Oct 1990, *Felger 90-472B* (ORPI) Dos Lomitas, *Rutman 24 Jul 2002* (ORPI) Hocker Well, 3 Dec 1990, *Felger* (observation)
CP Tule Well, 27 Nov 2001, *Felger 01-544* Papago Well, 13 Jun 1992, *Felger* (observation)

Tidestromia lanuginosa (Nuttall) Standley subsp. **eliassoniana** Sánchez-del Pino & Flores Olvera [*T. eliassoniana* Sánchez-del Pino]
Woolly honeysweet; *hierba ceniza, hierba lanuda*. Figure 32.

Summer-fall ephemerals, sometimes persisting until December but perishing with the first near-freezing temperatures. Plants often low and spreading, or the larger plants mound-shaped; stems often reddish. Pubescence dense and scurfy-whitish, with small, branched hairs (candelabriform; unique for the family in the flora area), often obscuring the leaf surfaces, or the plants sometimes more sparsely pubescent when well-watered. Leaves mostly opposite, occasionally alternate, petioled, the blades broadly obovate to orbicular, reduced and congested upwards and appearing whorled, the lower leaves often 1.5–3.5 (4.5) cm long, soon withering. Flowers bisexual, 2–2.5 mm wide and yellow, each produced in a small cup-shaped involucre growing around the flower; new involucres produced from the margin of the cups of older involucres; this proliferation results in highly clustered inflorescences, which continue through the season as long as moisture and warm weather hold out. Seeds globose.

Seasonally common and widespread across the flora area, especially at lower elevations on silty, sandy, and gravelly soils of desert flats, bajadas, washes, and roadsides, as well as rocky slopes and dunes. The above-average rainfall in the Organ Pipe region in 2012 was a banner year for *Tidestromia*. The plants were so large they overtopped *Ambrosia deltoidea* and *A. dumosa* and the plants were so dense that white bands or patches of *Tidestromia* could be seen on lower mountain slopes.

Two subspecies can be distinguished by presence or absence of decorations on the ends of the terminal arms of the branched hairs and pollen differences. Although the distinctions seem minor, they are geographically segregated. Subspecies *eliassoniana* occurs west of the continental divide in southwestern North America and subsp. *lanuginosa* occurs east of the divide (Sánchez-del Pino & Clemants 2003).

OP Armenta Well, *Warren 16 Nov 1974* Bull Pasture trail, 5 Nov 1977, *Bowers 952* (ORPI) Aguajita, wash, 14 Sep 1988, *Felger 88-408*

CP Daniels Arroyo at Charlie Bell Rd, 18 Aug 1992, *Felger 92-666* Pinta Sands, 15 Sep 1992, *Felger 92-761*

TA Coyote Water, 25 Oct 2004, *Felger 04-64* Tinajas Altas, 19 Mar 1998, *Felger* (observation, dry plants from previous year)

Figure 32 *Tidestromia lanuginosa* subsp *eliassoniana* Growler Valley, Organ Pipe (A) 9 Sep 2008, (B) 8 Oct 2006 W of mile 60, Hwy 85 (C) 6 Oct 2012, (D) 30 Sep 2006

ANACARDIACEAE Cashew Family

Rhus Sumac

Shrubs; leaves alternate, stipules none. Flowers bisexual or unisexual, small, 5-merous, with a ring-shaped nectary disk between the stamens and ovary. Fruit a small drupe.

1. Leaves simple (or sometimes also a few leaves with 3 leaflets), tough and rather shiny, essentially evergreen. ..... **Rhus kearneyi**
1. Leaves with 3 leaflets, thin and dull, winter deciduous. ..... **Rhus aromatica**

Rhus aromatica Aiton var. **trilobata** (Nuttall) A. Gray ex S. Watson
[*R. trilobata* Nuttall]
Skunk bush; lemonade bush; *limita*. Figure 33.

Slender-stem shrubs, 1.8 2.3 m tall. Leaves winter deciduous, (1.4) 2 4 cm long; leaflets 3 and thin, the margins shallowly lobed. Inflorescences terminal and axillary, with spike-like branches developing with the foliage in fall, overwintering, and producing small, white flowers late February and March before the leaves appear.

The leaves are moderately stinky when crushed, hence the common name. The fruits have a lemon-like taste, thus the Sonoran name *limita* (little lime).

Canyons and slopes in the Ajo Mountains, especially at higher elevations and on north-facing slopes. Another isolated, relictual population occurs at higher elevations in the Sierra Pinacate in nearby Sonora (Felger 2000).

It has been in the Ajo Mountains for at least 29,000 years ago. The fossil record indicates it was far more common in the late Wisconsin and early Holocene than today. It no longer grows near the rock shelters (Alamo Canyon and Montezuma's Head) where the middens were found. A similar or the same species grew at Tinajas Altas from at least about 9250 to 11,000 years ago.

This species complex ranges from Canada to southern Mexico and is taxonomically confusing with variously recognized varieties.

OP Alamo Canyon, 18 Dec 1939, *Harbison 25670* Arch Canyon, 1 Apr 1976, *Scaggs 2131* Bull Pasture, *Wirt 12 Nov 1989* (ORPI) †Alamo Canyon, seeds, 8130 to 29,110 ybp (6 samples, probably this species) †Montezuma's Head, seeds, 13,500 & 20,490 ybp
TA †*R.* cf *trilobata*, Tinajas Altas, seeds, 9230 to 11,040 ybp (5 samples)

Rhus kearneyi F.A. Barkley subsp. **kearneyi**
Desert sumac; *limita del desierto*. Figure 34.

Hardwood shrubs often 1.5 3.5 m tall, densely branched with dense foliage and relatively tough, inflexible branches. Leaves simple (rarely 3-lobed on long-shoots), 3.5–8.5 × 2–3.8 cm, ovate and entire, tough, bicolored, shiny green to somewhat bluish glaucous; leaf margins entire or sometimes irregularly undulate or serrate even on the same plant; crushed leaves have a fruity odor. Characteristically evergreen, but the leaves gradually shed during extended drought; the ground beneath the shrubs littered with dry leaves. During severe freezing weather in January 1987, cultivated plants in Tucson defoliated but rapidly recovered.

Inflorescences terminal, spike-like or paniculate, compact and densely flowered, mostly 1.5 3 cm long. Flowers white or pink; about 5 mm long; nectary disk of young flowers glistening yellow, with age becoming maroon-red. Fruits ripe November–March, ca. 1 cm long, orange and slightly fleshy when ripe, the surface covered with glands and wet with gooey but not sticky exudate, this liquid has a pleasant, tart (acidic) or citrus-like favor.

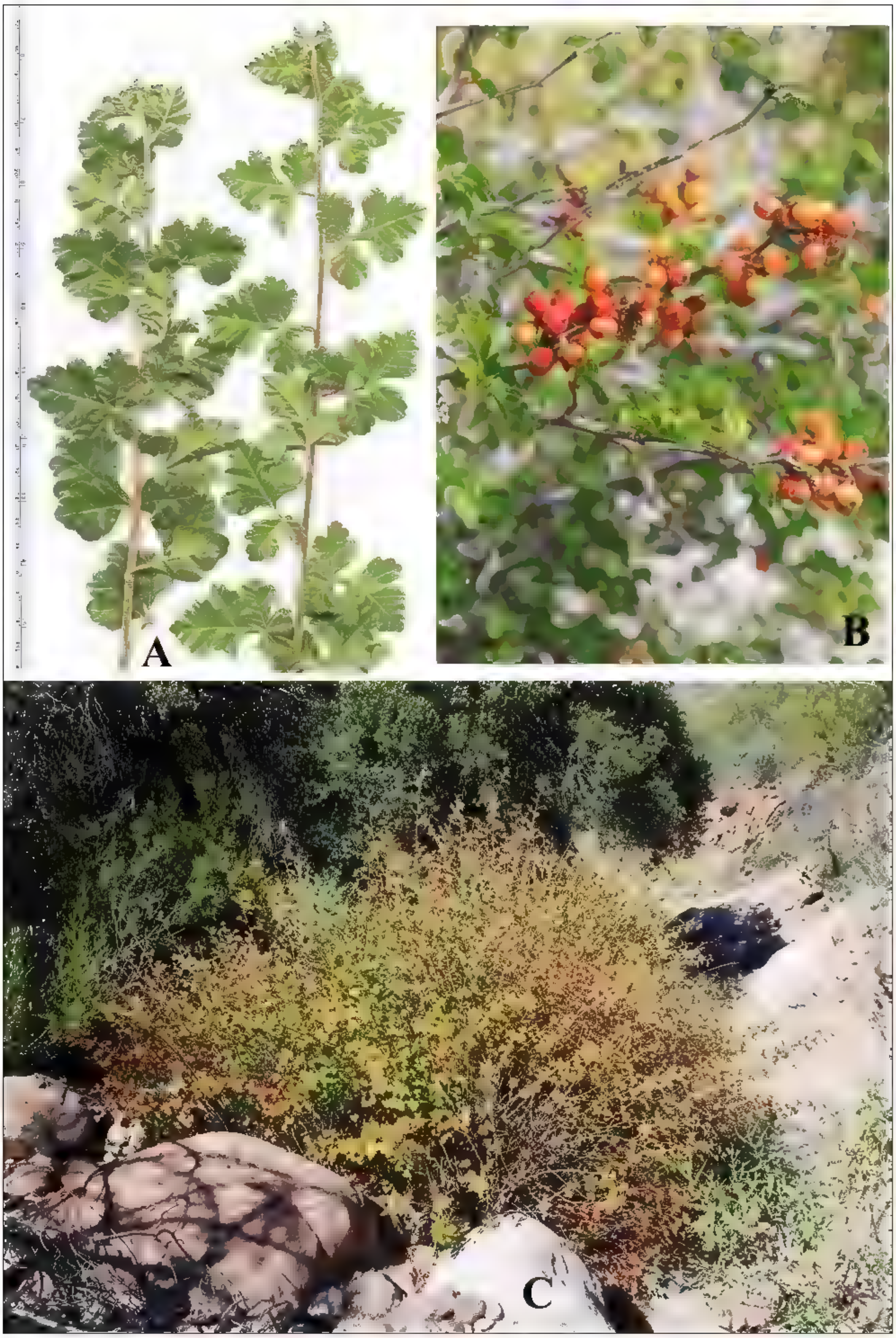

Figure 33 *Rhus aromatica* var *trilobata* Alamo Canyon, above Alamo Well (A) 17 Oct 2013, (C) 12 Jan 2013 (B) Palm Canyon, Joshua Tree National Park, CA, 1 May 2012

Figure 34 *Rhus kearneyi* subsp *kearneyi* Steep, N-facing granite slope S of MEX Hwy 2, Sierra Nina (= Sierra del Agula), Sonora, 17 Mar 2014

Concentrated in steep canyons and cliff bases on precipitous north-facing mountain slopes of the Cabeza Prieta, Tinajas Altas, and Gila Mountains, and adjacent granitic mountains in Sonora.

Disjunct populations of this subspecies also occur in Sonora in the Sierra del Viejo southwest of Caborca and in Baja California in the Sierra San Pedro Mártir. Two other subspecies occur in mountains of Baja California and Baja California Sur. *Rhus kearneyi* seems most closely related to *R. integrifolia* of the Pacific coast of the Californias.

CP Cabeza Prieta Mts Silver Star Canyon, *Simmons 27 Sep 1964*, Cabeza Peak, 14 Feb 1973, *Niehaus 980*

TA Tinajas Altas, 20 Nov 1913, *Goldman 2311* (US) Tinajas Altas Mts, 29 Mar 1930, *Harrison & Kearney 6573* (isotype) Borrego Canyon, 16 Jun 1992, *Felger 92-612*

APIACEAE (UMBELLIFERAE) Carrot or Parsley Family

Five species in the flora area are winter-spring annuals and one is an herbaceous perennial. Leaves alternate, sometimes in basal rosettes. Flowers small and radial. Perianth 5-merous; calyx reduced or absent; petals separate or absent; stamens 5; styles 2. Fruits dry, with 2 one-seeded segments (mericarps) almost always separating at maturity.

The *Daucus*, *Spermolepis*, and *Yabea* species are somewhat similar in appearance, but are readily distinguished by features given in the key.

1. Low-growing perennials with a thickened rootstock; Ajo Mountains. ..... **Lomatium**
1. Cool-season annuals with slender roots or a single tap root; various localities.

2. Plants stemless or with weak and trailing stems; herbage and fruits with stellate hairs; leaves simple, the blades wider than long, orbicular to palmately lobed. ..... **Bowlesia**
2. Plants stemless or with erect to spreading stems; glabrous or pubescent but the hairs not stellate; leaves pinnately deeply lobed or toothed to divided, longer than wide.

3. Leaves coarsely toothed; bracts stiff and spinescent at maturity; flowers and fruits sessile in dense head-like or cone-shaped inflorescences. ..... **Eryngium**
3. Leaves finely divided; leaves and bracts soft, not spinescent (fruits with spines); flowers and fruits pedicelled in rather open umbels.

4. Plants glabrous or slightly roughened; fruits rounded, 1.5 2 mm in diameter. ...**Spermolepis**
4. Plants pubescent with hispid hairs; fruits ellipsoid, 2.5 6.5 mm long.

5. Spines on fruits straight and with tiny barbs at the tip (use magnification); body of fruit 2.5 3 mm long. ..... **Daucus**
5. Spines on fruits hooked but not barbed; body of fruit more than 5 mm long. ..... **Yabea**

Bowlesia incana Ruiz & Pavón
Hoary bowlesia. Figure 35.

Delicate annuals with stellate hairs. Stems 4 45 cm long, slender, weak and often trailing. Leaves simple, petioled, the blades wider than long, 10 24 mm wide, with (3) 5 or 7 broad lobes. Flowers 2 6 on unbranched stalks shorter than the petioles; flowers minute, inconspicuous, and green and sessile, the sepals and petals scale-like, 0.5 mm long. Fruits of 2 ovoid-globose segments, each 2 2.4 mm wide.

Figure 35 *Bowlesia incana* (A) Plant, fruit (left), and flower, (B) volunteer in Ajo garden, 13 Feb 2005

Widespread in Organ Pipe and the eastern part of Cabeza Prieta including mountains and lowland habitats, often in shaded microsites beneath shrubs, in washes, sandy flats, and on north-facing rocky slopes

Presumed native in southwestern United States and northern Mexico, and disjunct in South America It has spread as a weed as far as Oregon and Florida and into eastern United States The genus is diverse in South America, *B. incana*, the only member in North America, presumably migrated from South America by natural means

OP Ajo Mts, 1 Apr 1944, *Clark 11550* (ORPI) 2 mi WSW of Bates Well, 30 Mar 1978, *Bowers 1132* International fence at El Papalote, adjacent to Aguajita Spring, 9 Apr 1986, *Felger 86-101* Alamo Canyon, *Wirt 13 Mar 1991* (ORPI)

CP Road to Agua Dulce Pass, 19 Mar 1987, *Elias 10202* San Cristobal Wash, 11 Apr 1992, *Harlan & Steinmann 150* (CAB) Charlie Bell Road near E boundary of Refuge, 25 Feb 1993, *Felger 93-50* Papago Well, 25 Feb 1993, *Felger 93-140*

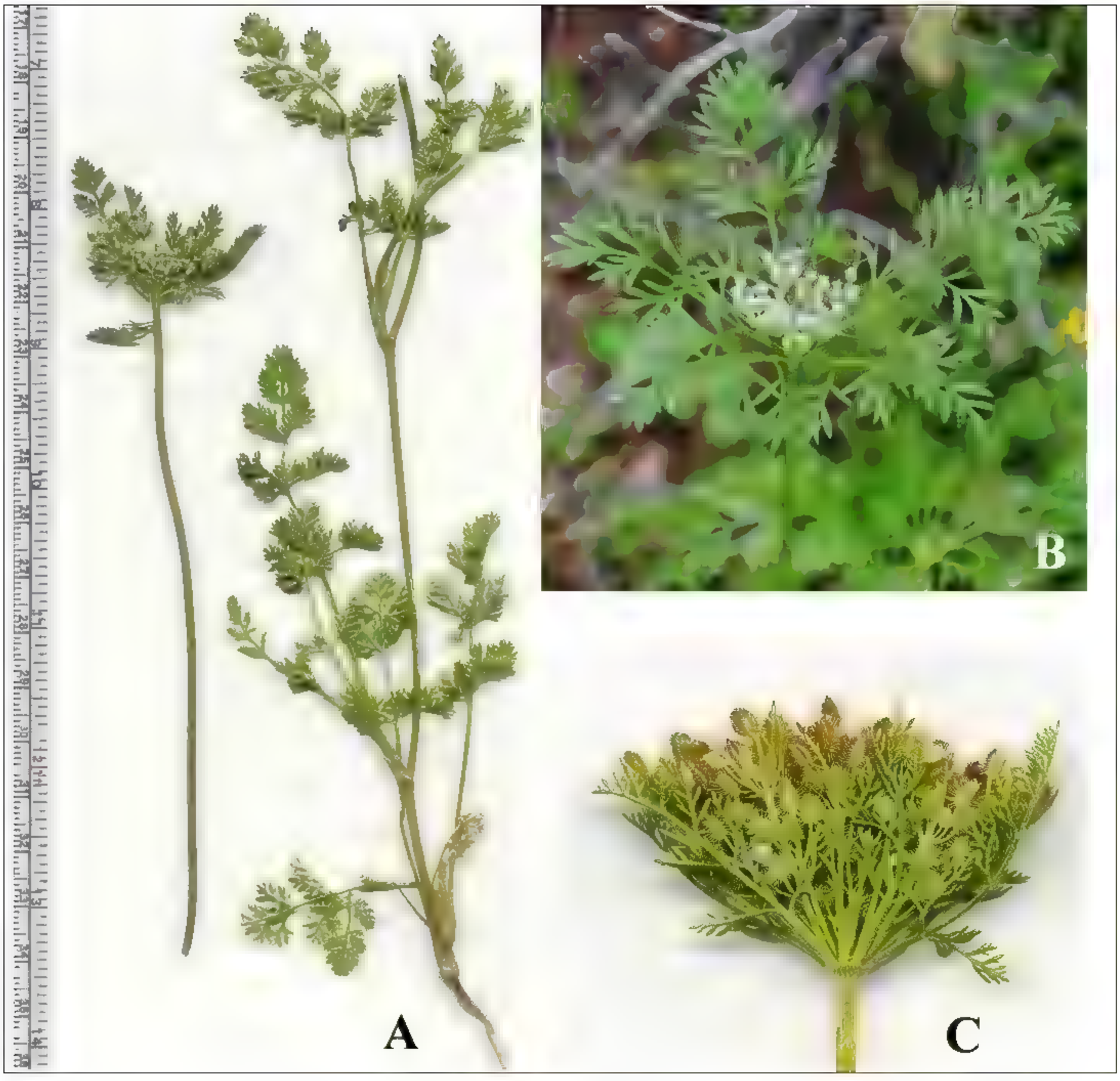

Figure 36 *Daucus pusillus* (A) Bull Pasture, 7 Mar 2014, (B) Estes Canyon, 18 Mar 2005, (C) trail to Bull Pasture, 21 Dec 2008

Daucus pusillus Michaux
American wild carrot; *zanahoria silvestre*. Figure 36.

Delicate annuals with stiff white (hispid) hairs sometimes bulbous-based on stems and inflorescence branches, and with a slender, orange tap root. Stems slender, 7 50 cm tall. Leaves lacey, highly dissected into small, narrow segments. Inflorescences 3.5 27 cm tall, of compound and densely flowered umbels on stout peduncles with leafy bracts. Petals 0.6 mm long, white or pale yellow. Fruits bur-like, 2.5 3 mm long, intricately sculptured with yellow barb-tipped spines.

Widespread and often common in Organ Pipe and Cabeza Prieta including washes, canyons, rocky slopes to peak elevations, and sometimes on dunes. It is one of the few winter ephemerals that grow on *Selaginella* slopes. There are no modern records from Tinajas Altas region but it grew there at least 9000 to 9800 years ago.

Western and southern United States, northern Mexico, and South America.

OP Alamo Canyon, *Nichol 26 Mar 1939* Senita Basin, 23 Mar 1969, *Lehto 15406-b* (ASU) Slopes NW of Pinkley Peak, *Rutman 24 Mar 2001* (ORPI) Armenta Road, 1 4 mi W Hwy 85, 11 Mar 2003, *Felger 03-266* Middle fork of Alamo Canyon near crestline of Ajo Mts, 15 Mar 2003, *Rutman 2003-322* (ORPI)

CP Charlie Bell Pass, 3 Apr 1992, *Whipple 3922* (CAB) Bassarisc Tank, 26 Feb 1993, *Felger 93-122*. Childs Mt, 2240 ft, 9 Apr 1993, *Felger 93-275* Charlie Bell Road at Daniels Arroyo, 10 Apr 1993, *Felger 93-343* Pinta Sands, 11 Apr 1993, *Felger 93-422* Las Playas, 2 Mar 1998, *Harlan 502*

TA †Tinajas Altas, fruits, 8970 & 9790 ybp

Eryngium nasturtiifolium de Jussieu ex F. Delaroche
Hierba del sapo. Figure 37.

Winter-spring annuals (often biennial or perennial outside the desert), glabrous, 3 12 cm wide, usually with a stout taproot. First leaves in a basal rosette, 1.5 6+ cm long, thin, green, soon withering. Leaves pinnatifid-toothed, the teeth sharp- or spine-tipped. Inflorescences densely flowered and cone-shaped, subtended by leaf-like bracts. Flowers minute; sepals 1.6 2.5 mm long and sharp pointed; petals 0.5 mm long, white, and soon deciduous.

Figure 37 *Eryngium nasturtiifolium*. Represo de Ortega (S of Las Playas, Cabeza Prieta NWR), Sonora, 11 Apr 2014

Locally common in poorly-drained clay soils of dirt tanks and playas, growing as the water recedes Seasonally abundant across Las Playas and Dos Playas during favorable years In Arizona known only from Cabeza Prieta, Cameron Tank just east of Cabeza Prieta and southwest of Ajo, and near the Mexico border in the Tohono O'odham lands It is locally common in similar habitats northwestern Sonora

Southern Arizona, Texas, through much of Mexico, and Cuba

CP Las Playas, 10 Apr 1978, *Lehto L22460* (*n* 16, ARIZ, ASU) Dos Playas, 7 Apr 1979, *Lehto L-23594* Jose Juan Tank, 26 Feb 1993, *Felger 93-96*

Lomatium nevadense (S Watson) J M Coulter & Rose
Biscuit-root Figure 38

Herbaceous perennials Herbage grayish green Leaves basal, to ca 15 cm long, 2- or 3-times pinnately dissected Flowers in compound umbels, dull purplish whitish and minute Fruits ca 1 cm long, compressed, winged and ribbed

Figure 38 *Lomatium nevadensis* (A) Hoodoo Canyon, Burro Mts, Grant Co , NM, 23 Feb 2010, (B) Knight Mt, Burro Mts, NM, 21 Mar 2009, photos by Russell Kleinman (gilaflora com) (C) Crest of Ajo Mts, middle fork of Alamo Canyon, 27 Mar 2005

Locally common at higher elevations in the Ajo Mountains The nearest population is in the Baboquivari Mountains

Western North America and northwestern Mexico The Ajo Mountain plants are var *pseudorientale* (M E Jones) Heller, although the varieties seem poorly defined

OP Near crestline of Ajo Mts, middle fork Alamo Canyon, intershrub spaces, associated species *Juniperus*, *Nolina*, *Vauquelinia*, *Viguiera*, *Menodora*, *Simmondsia*, *Yucca*, *Selaginella*, 3400 ft, 15 Mar 2003, *Rutman 2003-333* (ORPI)

Spermolepis lateriflora G L Nesom
Bristly scale-seed Figure 39

Small annuals, glabrous Leaves dissected into thread-like or linear segments Flowers minute, petals white Fruits rounded, 1 5 2 mm wide, ribbed, and with short bristles

Along washes in the eastern part of Cabeza Prieta and widely scattered in Organ Pipe, especially in the Ajo Mountains

Western and southern Arizona, southern New Mexico, west Texas, Sonora, and Chihuahua, and in California probably adventive

Spermolepis lateriflora (segregated from *S. echinata* by Nesom 2012) is similar to *S. echinata* in its fruits densely echinate-bristly with uncinate hairs but distinct in its sessile umbels (Nesom 2012) The two species are allopatric, with *S. echinata* occurring from Texas eastward in se USA and in northeastern Mexico

Figure 39 *Spermolepis lateriflora* (A) Engineer Canyon, Burro Mts, NM, 12 Apr 2008, (C) Sycamore Canyon near Cliff, Grant Co , NM, photos by Russell Kleinman (gilaflora com) (B) Texas Canyon, Organ Mts, NM, 15 May 2010, photo by Patrick Alexander (SEINet)

OP Alamo Canyon, *Nichol* 26 Mar 1939 Washes near Sonoyta Hills, 10 Apr 1941, *McDougall 69* Arch Canyon, 2800 ft, 5 Apr 1978, *Bowers 1192* Gunsight Hills, *Rutman 4 Apr 1998* (ORPI) N-central Puerto Blanco Mts, *Rutman 7 Apr 1998* (ORPI) Santa Rosa Mts, foothills, 2 Apr 2003, *Rutman 2003-446* (ORPI)

CP Daniels Arroyo at Charlie Bell Rd, 10 Apr 1993, *Felger 93-360*

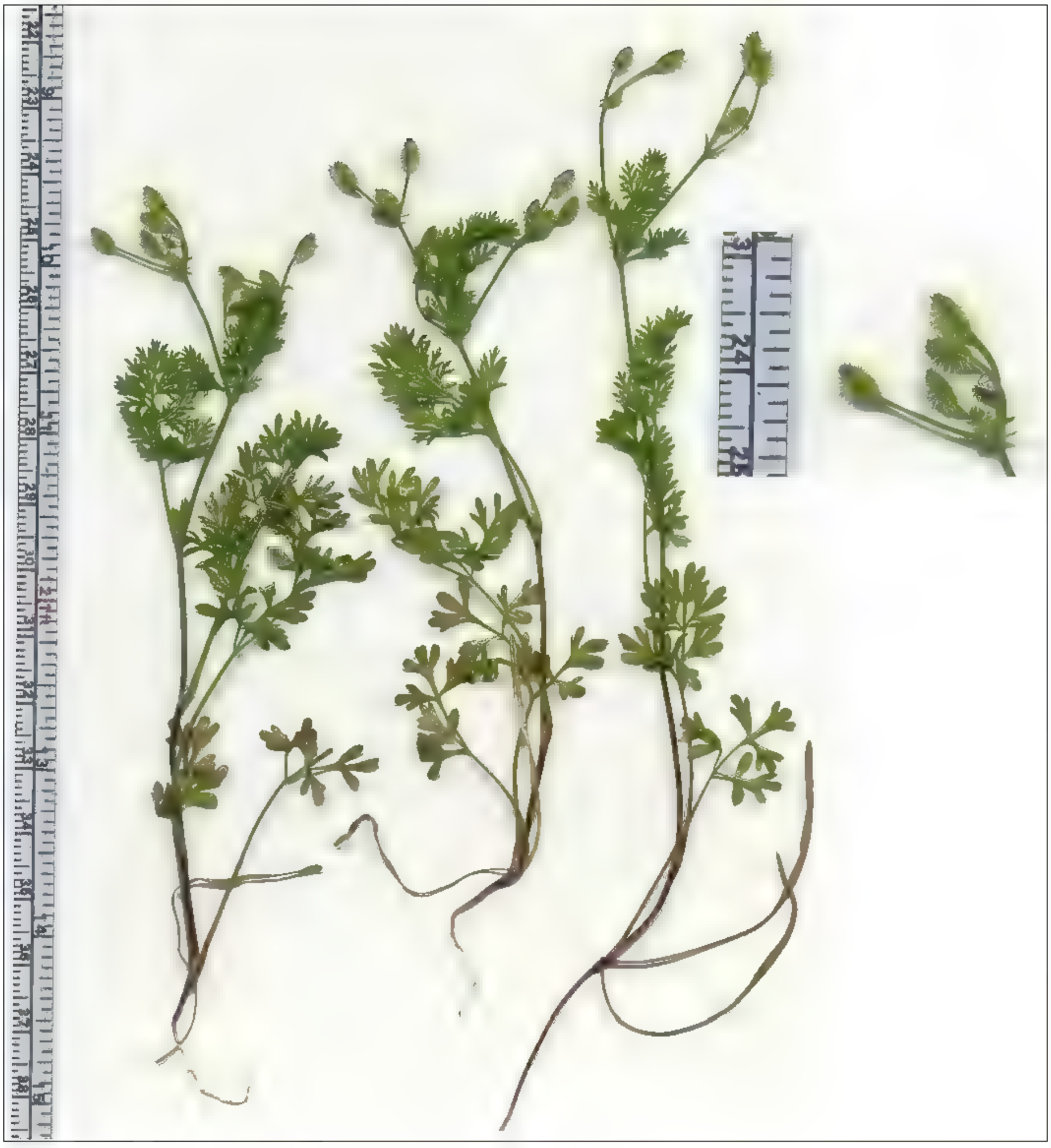

Figure 40 *Yabea microcarpa* Bull Pasture, 7 Mar 2014

Yabea microcarpa (Hooker & Arnott) Koso-Poljanski
[*Caucalis microcarpa* Hooker & Arnott]
False carrot Figure 40

Small, cool-season annuals, with hispid hairs, and similar to the more widespread *Daucus pusillus* Leaves finely divided into thread-like or linear segments Flowers in rather open umbels,

minute, with white petals. Fruits ellipsoid, the body 5 6.5 mm long, with hooked (but not barbed) spines.

Organ Pipe in the Ajo and Bates Mountains, especially at higher elevations.

Western North America from Baja California and Sonora to British Columbia, Idaho, and New Mexico.

OP N slope Bates Mts, 18 Mar 1944, *Clark 11405* (ORPI) Saddle between Boulder and Arch Canyons, 3800 ft, 3 May 1978, *Bowers 1288a* (ORPI) Estes Canyon, N-exposure, *Wirt 1 Apr 1990* Crestline of Ajo Mts, 26 Mar 2005, *Rutman 20050326-1.*

APOCYNACEAE Dogbane Family (includes Asclepiadaceae)

Perennials herbs, vines, or shrubs (in the flora area), many with milky sap. Leaves mostly opposite. Flowers radial, 5-merous, and insect-pollinated. Fruits mostly many-seeded (few seeded in *Matelea parvifolia* and *Metastelma*), the seeds bearing silky hairs and wind-borne.

1. Stems erect or spreading, not vining or twining.

2. Sap conspicuously milky; flowers green and white to cream or pinkish; fruits mostly ovoid (narrower in *A. albicans* and *A. subulata*), more than 5 mm wide. ..... **Asclepias**
2. Sap not milky; flowers bright yellow, fruits long and slender, less than 2 mm wide. ..... **Haplophyton**

1. Stems vining or trailing, not self-supporting.

3. Leaf blades arrow-shaped or broadly heart-shaped, often less than twice as long as wide. .....**Matelea**
3. Leaf blades linear to lanceolate, more than twice as long as wide, rarely very narrowly arrow-shaped.

4. Stems glabrate or sparsely pubescent with scattered, straight hairs; flowers more than 5 mm wide, the corolla rotate with surfaces readily visible. ..... **Funastrum**
4. Stems with a longitudinal line of usually curved hairs between the nodes; flowers less than 4 mm wide, the corolla campanulate with the inner surfaces of lobes obscured by hairs. ..... **Metastelma**

Asclepias – Milkweeds

Perennials; the stems not vining. Flowers in umbellate clusters. Corolla lobes often reflexed and obscuring the calyx. Fruits linear to broadly ovoid. Seeds many, flat, lightweight, with silky hairs at the apex.

Like many other asclepiad genera, the pollen is massed into paired pollinia (waxy, sac-like structures) joined by a wishbone-shaped translator arm to a corpusculum. The corpusculum may be engaged by the leg, hair, or tongue of an insect, which in its search for nectar carries the pollinium to another flower. Pollination is achieved when an insect visits another flower and inadvertently inserts the pollinium into the slit between adjacent anthers. Wasps (spider wasps, tarantula hawks) and bees seem to the be the primary pollinators in the flora area. Orchids are the only other plants with similarly complex pollinaria.

1. Leaves ovate, at least 2 cm wide.
   2. Plants often more than 1 m tall; leaves sessile, the margins minutely ragged. ... **Asclepias erosa**
   2. Plants usually less than 0.4 m tall; leaves petioled, the margins entire. **Asclepias nyctaginifolia**

1. Leaves linear, less than 2 mm wide (leaves long-lived or quickly deciduous and the stems thus often leafless).

   3. Stems brown, not succulent, not reed-like; leaves more or less persistent, alternate, and very close together, the internodes shorter than the leaves. ..... **Asclepias linaria**
   3. Stems whitish or bluish green, semi-succulent and reed-like; leaves sparse, opposite, and quickly deciduous, the internodes longer than the leaves; reed-stem milkweeds.

      4. Stems usually relatively few (or sometimes as many as 50), usually 1.5 3 m tall; flowers 8 9 mm long (including the down-turned petals), the hoods 2 2.5 mm long and not taller than the fused anthers. ..... **Asclepias albicans**
      4. Stems many, usually to 1 1.5 (2) m tall; flowers 15 20 mm long (including the down-turned petals), the hoods 6 10 mm long and obviously taller than the fused anthers. ..... **Asclepias subulata**

Figure 41 *Asclepias albicans* (A) Southern Cabeza Prieta Mts, 16 Jan 2005 Plant grown from seed from Cabeza Prieta Mts (B) 6 May 2005, (C) 14 Aug 2014

Asclepias albicans S. Watson
White-stem milkweed; *jumate, candelilla*. Figure 41.

Several or more slender, erect, semi-succulent stems to 3 m tall. Leaves few, linear and very quickly deciduous. Umbels 1 to several per stem, from the upper nodes. Flowers cream-white, often suffused with pink, with age turning pale yellowish; corolla lobes 6 7 mm long, the hoods 2 2.5 mm long. Fruits 7.5 15 cm long. Flowering during warmer months.

Arid and exposed, sparsely vegetated rocky hillsides and mountain slopes in Cabeza Prieta and Tinajas Altas, and occasionally on sandy-gravelly soils of bajada-plains along the east side of the Tinajas Altas Mountains. It has been in the Tinajas Altas region for at least 8600 years.

Southeastern California, western Arizona, both Baja California states, and northwestern Sonora.

It is amazing to see these strange slender wand-like stems waving in hot winds on dry slopes, with big orange and black tarantula hawks (spider wasps) clinging to the bobbing flower clusters. The young stems and inflorescence branches of *A. albicans* and *A. subulata* are often covered with yellow aphids (*Aphis nerii*, the oleander aphid, native to the Old World and now widespread). Bright red nymphs and the black and red adults of the small milkweed bugs (*Lygaeus kalmi*) feed on the both reedstem species. *Asclepias albicans* has fewer and taller stems than *A. subulata,* but young plants are often many-stemmed like those of *A. subulata.*

CP 3 mi W of Tule Well, 1 Apr 1976, *Engard 912* (ASU) Tule Tank drainage, 23 Mar 1992, *Harlan 119* (CAB) Childs Mt, 9 Apr 1993, *Felger 93-300* Eagle Tank and Buckhorn Tank, 13 & 14 Jun 1992, *Felger* (observations)

TA Tinajas Altas, 27 Mar 1932, *Shreve 5941* †Butler Mts, twigs, 3820 & 8570 ybp †Tinajas Altas, 1230 to 5080 ybp (3 samples)

Asclepias erosa Torrey.
Giant sand-milkweed, desert milkweed; *hierba del cuervo*. Figure 42.

Plants robust, often 1 2+ m tall, with copious milky sap, the stems single or multiple from a perennial caudex with a stout, fleshy taproot. Herbage and inflorescences white woolly when young, glabrate with age. Leaves mostly 13 23 × 9.5 13 cm, broadly ovate below to ovate-lanceolate above, nearly sessile, thick and firm, the midrib and lateral veins prominent, the margins thickened and ragged (erose). Sepals green and pubescent; corollas 8 9 mm long, greenish white, the hoods 4 5 mm long, white. Fruits 5 8 cm long. Growing from winter to early summer; flowering mostly late spring and sometimes in early summer.

Widely scattered, usually as small, localized populations in washes and sand flats in the southwestern part of Cabeza Prieta and westward in southwestern Arizona and adjacent extreme northwestern Sonora.

Also Baja California, southeastern California, southern Nevada, southwestern Utah, and western Arizona.

Flowers visited by large orange and black spider wasps (*Pepsis* and *Hemipepsis*), large yellow-banded tiphiid wasps, and hairstreak butterflies. The wasps can be seen avidly drinking floral nectar in the hot sun. Many orange and black milkweed bugs (*Lygaeus* and *Oncopeltas*) are invariably present, often sucking from unripe fruits, and the flower clusters are often visited by numerous ants tending yellow aphids. It is amazing to find this rather large plant with its large leaves in full flower in intense heat of early summer when almost all other herbaceous plants are dormant or have perished. Does this milkweed grow from a large underground water-storage tissue, and or do the roots penetrate deeply in the desert sand?

Figure 42. *Asclepias erosa*. (A) Mohave Valley, Mohave Co., AZ, 19 May 2011, photo by Ries Lindley, (B) Calico Basin, W of Las Vegas, NV, May 2005, photo by Stan Shebs (commons wikimedia org)

CP: Tule Well, 16 Jun 1992, *Felger 92-622*.

TA: Lechuguilla Desert, *Simmons 21 May 1965*. Camino del Diablo at 0.3 mi W of Cabeza Prieta boundary, 29 Nov 2001, *Felger* (observation).

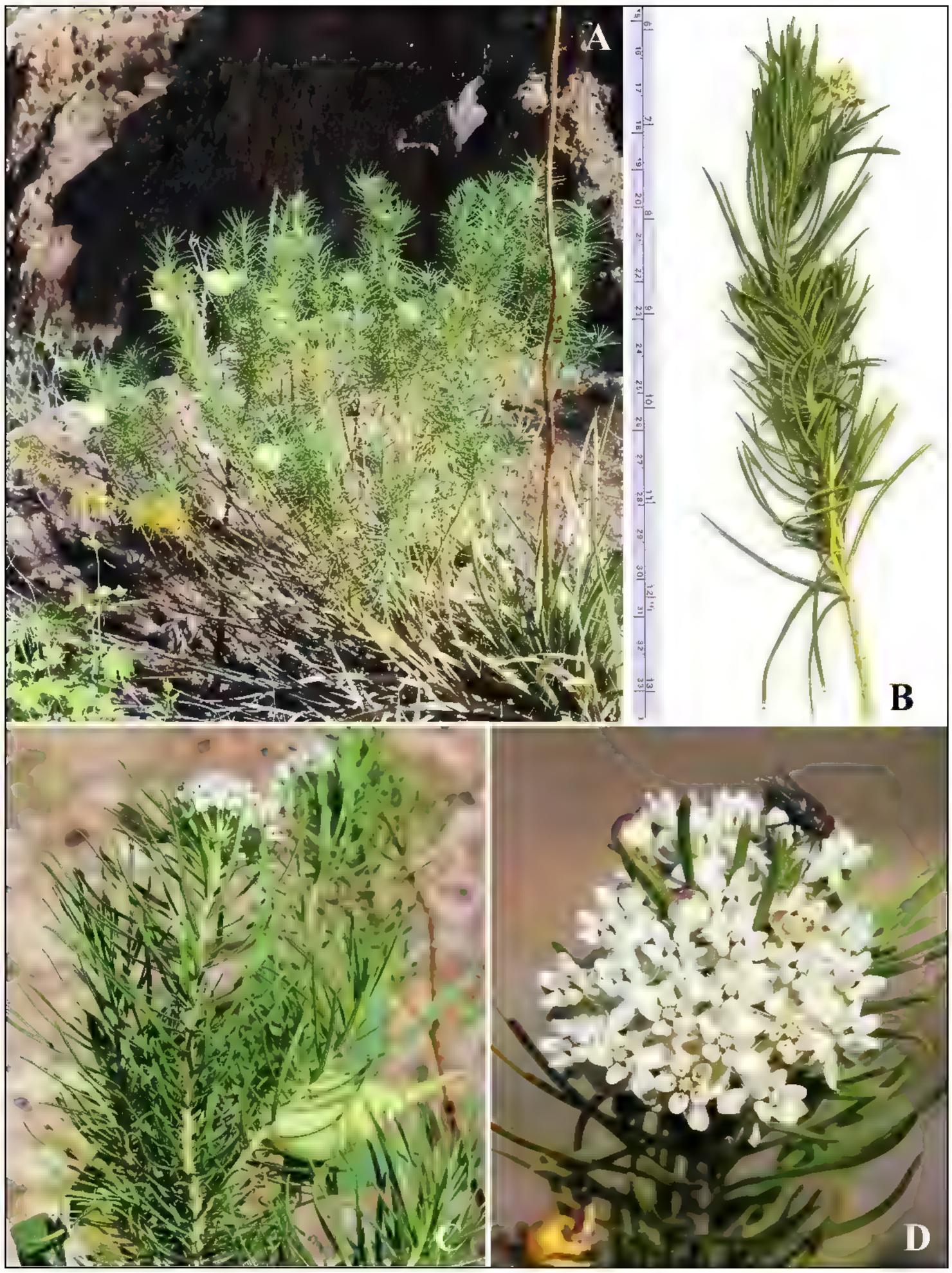

Figure 43. *Asclepias linaria*. (A & B) Estes Canyon, along trail to Bull Pasture, 25 Sep 2013; (C) Arch Canyon, 12 Sep 2013; (D) trail to Bull Pasture, 10 Apr 2005.

Asclepias linaria Cavanilles

Narrow-leaf milkweed. Figure 43.

Small shrubs. Leaves crowded towards the stem tips, sessile, needle-like, about 1 mm wide. Umbels borne near the stem tips. Flowers small, white and pale pinkish, corolla lobes 4–5 mm long. Fruits 3–6 cm long. Growing and flowering with warm weather.

Higher elevations in the Ajo/Diablo mountain complex; scattered and generally on rocky

slopes and drainages This population is the westernmost for this widespread species and a notably isolated population stranded on an ecological island

Southern Arizona at elevations above the desert and mountains through much of Mexico except the Baja California Peninsula

OP Pitahaya Canyon, *Nichol 23 Feb 1939* Alamo Canyon, 3000 3800 ft, 31 Mar 1948, *Darrow 3856*

Figure 44 *Asclepias nyctaginifolia* Wash bed near N boundary of Organ Pipe & Hwy 85, 14 Aug 2013

Asclepias nyctaginifolia A Gray
Mojave milkweed Figure 44

Herbaceous perennials from a thick and deeply buried rootstock, dying back in drought or following freezing weather, and new shoots emerging in early spring or summer Herbage pubescent Stems spreading or upright Leaves petioled, the blades relatively thick, dark green, often with reddish veins, and with a wavy (undulate) surface, 3–12 cm long, broadly lanceolate to ovate Flowers greenish, the corolla lobes 12–15 mm long, the fresh coronas white (becoming yellowish to orange with age) Fruits 5–9 cm long Flowering in April and with summer rains

Widely scattered and sometimes locally common across most of Organ Pipe, mostly along washes in valley plains and on hillsides

Southeastern California and southern Nevada to New Mexico and northern Sonora.

OP Just N of Mile Post 6, Puerto Blanco Drive, 1723 ft, *Beale 26 Mar 1988* (ORPI) Armenta Well, *Wirt 10 Aug 1990* Cherioni Wash, ca 1 mi W of Hwy 85, *Rutman 6 Jun 1998* (ORPI) Cipriano Hills near Pozo Nuevo Road, *Rutman 30 Aug 2001* (ORPI)

Asclepias subulata Decaisne
Desert reed-stem milkweed, rush milkweed; *jumete, candelilla.* Figure 45.

Stems many, slender, semi-succulent and erect, mostly 0.8–1 m tall. Leaves narrowly linear, 1.5–4+ cm long, 0.5 mm wide, few, and quickly deciduous. Umbels 1–several per stem, from upper nodes. Flowers waxy, cream (fading yellowish), the corolla lobes 9–11 mm long, the hood 7–10 mm long. Fruits 8.5–15 cm long. Flowering profusely at various seasons; often one of the few (or the only) plants flowering in late May and June, especially in roadside habitats. Flowers frequented by the large orange-winged tarantula hawk wasp (*Hemipepsis* sp.) and at least one other spider wasp (*Pepsis thisbe*).

Mostly on sandy soils, widely scattered and generally uncommon in the flora area, often solitary or with a few nearby plants. Rare in the southwestern part of Organ Pipe, and slightly more numerous in the southern part of Cabeza Prieta, and occasional in the Lechuguilla Valley of Tinajas Altas region. Common in nearby northwestern Sonora.

Figure 45 *Asclepias subulata* (A) Dunes S of Sierra Blanca, Pinacate Reserve, Sonora, 17 Feb 2008 Plant grown in Ajo from seed collected along MEX Hwy 8, S of Sierra Blanca (B) 14 May 2006, (C) 14 Aug 2013

Grossly similar to *A. albicans* but with shorter, more numerous, and greener stems, and larger and differently shaped flowers. The two species are closely related (Fishbein et al. 2011).

Western Arizona, southern Nevada, and southeastern California to southwestern Sonora and Baja California Sur.

OP 1 mi N of Quitobaquito, roadside, 13 Sep 1978, *Bowers 1538* (ORPI) 0.5 mi E of Aguajita Wash, North Puerto Blanco Road, *Rutman 28 May 1996* (ORPI)
CP Las Playas, 24 Nov 1994, *Harlan 447* S of Jose Juan Tank, in wash, *Balaban 26 Jun 1996* (CAB) Observations Camino del Diablo 0.8 mi E of W Boundary of Refuge, 29 Nov 2001, *Felger & McCasland*, 9.3 mi E Pinta Sands on Camino del Diablo, 28 Nov 2001, *Felger*
TA Camino del Diablo, SE of Raven Butte, 25 Oct 2004, *Felger 04-03.*

Funastrum hartwegii (Vail) Schlechter
[*F. cynanchoides* (Decaisne) Schlechter var. *hartwegii* (Vail) Krings. *F. heterophyllum* (Engelmann) Standley. *Sarcostemma cynanchoides* Decaisne subsp. *hartwegii* (Vail) R.W. Holm]
Climbing milkweed; *güirote*. Figure 46.

Vines twining into shrubs and trees, sometimes climbing up saguaros or sprawling across the ground; larger individuals in favorable habitats tend to have moderately woody, or corky, basal stems, and other individuals may be herbaceous perennials and not woody or corky. Stems dying back during drought. Crushed herbage and even lightly brushed plants are strongly malodorous. Herbage glabrate or sparsely pubescent. Leaves 3–15 cm long, linear to narrowly triangular, often hastate or sagittate at the base, with one or more yellow-brown conical glands (colleters; drying brown) 0.2–0.4 mm long on upper leaf blade surface at the midrib base. Leaves drought deciduous, leaving long leafless stems trailing and twining along wash bottoms and on vegetation. Flowers maroon and white; corollas 5.5–7.5 mm wide, maroon and white, the margins ciliate; corona and vesicles white. Flowering at various seasons. Fruits 6.5–8.5 cm long, elongated (fusiform) and smooth.

Widespread across lowland areas, foothills, and lower mountain slopes; mostly along washes, especially major arroyos, and also in rocky places. Surprisingly, it even ranges in the hyperarid Butler Mountains west of the Tinajas Altas Mountains.

Central Mexico to southwestern United States.

The sap was widely used by the Hia-Ced O'odham as chewing gum (Philip Salcido & Delores Lewis in Felger et al. 1992). "Set it on the fire and it would become tacky and we would chew it ... has a milky sap ... gather it and heat it up and add water and it becomes white and we chew it" (Betty Melvin in Zepeda 1985: 48, 76). The fresh flowers are marginally edible with an onion-like flavor (Felger & Moser 1985).

OP Bates Well, *Nichol 26 Apr 1939* Alamo Canyon, 2000 ft, *Tinkham 18 Apr 1942* Growler Mts, 16 Apr 1953, *Parker 7982* Quitobaquito, 14 Sep 1988, *Felger 88-453*
CP Monreal Well (Simmons 1966) Buck Mt, *Duncan 28 Mar 1970* (CAB) Papago Well, 20 Mar 1992, *Harlan 45* (CAB) Eagle Tank, Little Tule Well, 12 & 13 Jun 1992, *Felger* (observations)
TA Tinajas Altas, *Van Devender 9–10 Mar 1980.* Butler Mts, *Van Devender 27 Mar 1983.* Coyote Water, 25 Oct 2004, *Felger 04-46*

Figure 46 *Funastrum hartwegii* (A) Little Ajo Mts, 7 May 2006, (B) Kuakatch Wash E of Hwy 85, 10 Sep 2013, (C) Alamo Canyon, 7 Apr 2005, (D) Ajo, 21 Mar 2008

Haplophyton cimicidum A de Candolle var **crooksii** L D Benson
[*H. crooksii* (L D Benson) L D Benson *H. cinereum* (A Richard) Woodson *Echites cimicidus* Pavón ex de Candolle *E. cinereus* A Richard]
Cockroach plant, *hierba de la cucaracha* Figure 47

Spindly to bushy perennials with very slender straight stems Leaves drought deciduous,

opposite and/or alternate especially above petioles short, the blades lanceolate, thin, often ca. 2–3 cm long. Flowers bright yellow and showy, the floral tube ca. 1 cm long, flowering at various seasons following rainfall, mostly summer rain. Capsules paired, 6–10 cm long and very slender, 2–2.5 mm wide; seeds black with a tuft of hairs at each end.

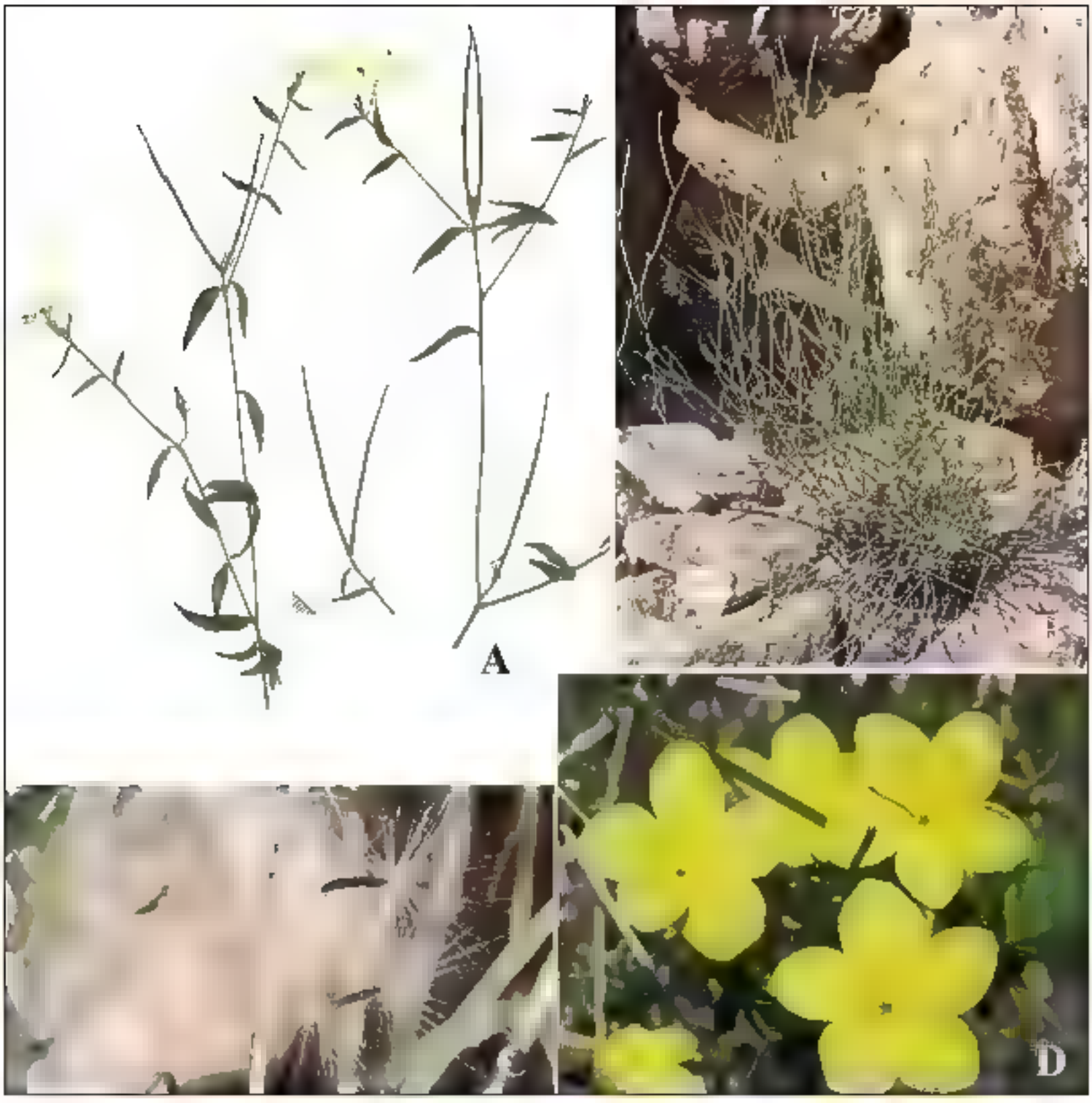

Figure 47. *Haplopappus cinereus*. A. Upper San Pedro River floodplain, Charleston Hills, Cochise Co., 8 Sep. 2002 (*Malusa 1342*, ASU). (B–D) Aramo Canyon above the well, 7 Feb. 2013.

Ajo and Puerto Blanco Mountains, generally on north facing slopes in protected places, canyons, and at higher elevations.

Southern Arizona to west Texas and southward to Guatemala; reports from the Caribbean are based on the dubious location of the type of *H. cinereus*. The plant has been used an insecticide in Mexico, hence the common name. In 1942 Benson described the northern populations as var.

crooksii in southern Arizona and northern Sonora, differentiated mostly by smaller leaves and seeds, and seed surfaces with some difference in ornamentation. One year later he recognized the variety as a distinct species. Williams (1995) presents a case for recognizing the two taxa at the species level, citing differences in seed size, color, and ornamentation, corolla aestivation, and an apparent disjunction in the distribution in Mexico (but with all Sonoran populations attributed to the northern taxon). The Sonoran Desert populations have smaller leaves than those beyond the desert in southern Sonora, which overlap considerably with southern Mexican populations in the diagnostic traits cited by Williams (1995).

OP Estes Wash in side canyon, 20 Aug 1950, *Supernaugh 432* Side canyon of Grass Canyon, 12 Sep 1978, *Bowers 1516* Arch Canyon (NE of the arch), *Wirt 30 Sep 1989* (ORPI) Puerto Blanco Mts, foothills of Pinkley Peak, 31 Oct 2003, *Rutman 20031031-33*

Matelea

Vines, the herbage foul-smelling when crushed. Leaves opposite, the leaf blade bases cordate or sagittate. Corona a deeply 5-lobed ring. *Matelea* is polyphyletic and very heterogeneous. (Mark Fishbein, pers. com. to Richard, Jan 2013).

1. Leaves 2–10 cm long, thin and broadly heart-shaped (cordate); flowers cream; fruits smooth, more than 8 cm long. ..... **Matelea cordifolia**
1. Leaves less than 2 cm long, somewhat thick and arrow-shaped; flowers brownish or greenish; fruits less than 6 cm long, with few, short tubercles. ..... **Matelea parvifolia**

Matelea cordifolia Woodson
[*Rothrockia cordifolia* A. Gray]
Heart-leaf milkweed vine. Figure 48.

Woody-based vines with corky bark growing through desert shrubs and trees, densely pubescent, with long straight hairs and shorter glandular hairs. Leaves drought deciduous, long petioled, the blades to 10+ cm long, thin and more or less heart shaped. Corollas about 15 mm long, lobed nearly to the base, cream-colored and faintly lined, the corona mostly hidden within the corolla tube, green. Fruits about 10 cm long, elongated, smooth, mottled green and whitish. Flowers, fruits, and foliage produced at various times of the year following rainy periods except during the coldest weather.

Known from the United States only in canyons in the Ajo and Diablo Mountains and from the type collection in Arizona in 1884, probably in mountains near Tucson. It has not been recorded in the Diablo Mountains since the 1951 collection. Sue Rutman (2014) reports, "I've looked for but never found any *Matelea cordifolia* in Diablo Canyon, where Supernaugh found it. I found a single non-reproductive plant in Alamo Canyon in 1996. It remained non-reproductive through 2002, but has not been seen since. I suspect that the deep drought of 2002 killed it." It does, however, occur in Sonora near the southeastern part of Organ Pipe.

Mexico in Sonora, Isla Tiburón, and Baja California Sur.

OP Canyon Diablo, 15 Apr 1951, *Supernaugh 440* (ORPI) Alamo Canyon, *Rutman 9 Apr 1996* (ORPI)

Sonora Mpio General Plutarco Elías Calles, Sierra Cubabi (SE of Sonoyta), N-facing drainage at middle elevation, [31 72143°N, 112 82064°E in SEINet], 700 m SE of highest point in area, 1130 m, granite with *Stenocereus thurberi, Justicia californica, Fouquieria splendens, Simmondsia chinensis, Ferocactus covillei, Eriogonum wrightii, Encelia farinosa*, woody vine growing up through *Vauquelinia californica*, 19 March 1991, *Baker 8131* (ASU)

ASU
ASU0013413
ASCLEPIADACEAE OF MEXICO
Sonora
Matelea cordifolia (Gray) Woods
N 35 11 000 E 3 27 500; ca. 700 m SE of highest point in area, 1130 m elev granite with Stenocereus thurberi Justicia californica Fouquieria splendens Simmondsia chinensis Ferocactus covillei Euphorbia w gbl. Lycium fremontii
Woody vine growing up through Vauquelinia californica
Marc A. Baker 8131 and Bob Johnson
19 March 1991

Figure 48. *Matelea cordifolia*. Sierra Cubabi, Sonora, 19 Mar1991, *Baker 8131* (ASU, from SEINet)

Matelea parvifolia (Torrey) Woodson
Spearleaf milkweed vine. Figure 49.

Small perennial vines, pubescent but not glandular, the hairs curving downward. Leaves less than 2 cm long, dull green, somewhat thick, ovate to arrow-shaped (triangular-lanceolate). Flowers greenish to dark brown-purple, 5 mm long. Fruits mostly less than 6 cm long, slender with few short, blunt tubercles.

Widespread and easily overlooked, on rocky slopes through much of Organ Pipe including the Ajo Mountains and localized in washes at the northeastern corner of Cabeza Prieta.

Southeastern California to Arizona, Trans-Pecos Texas, and adjacent northern Mexico.

Figure 49 *Matelea parvifolia* (A) Victoria Mine area, 12 Sep 2013, (B) bajada S of Ajo Mts, 2 Mar 2008

OP: Near mouth of Alamo Canyon, *Mulroy 2 May 1970.* Bull Pasture, 2 May 1978, *Bowers 1272* (ORPI). Grass Canyon, 9 Dec 1978, *Bowers 1515.* Foothills, NW part of Puerto Blanco Mts, 7 Mar 2002, *Rutman* (observation).

CP: Charlie Bell Rd, 1.9 km NE of Little Tule Well, 5 Mar 1994, *Felger 94-29.*

Figure 50. *Metastelma arizonicum.* (A) Middle fork of Alamo Canyon, 24 Mar 2008; (B) trail to Bull Pasture, 21 Sep 2008; (C) Arch Canyon, 14 Sep 2013.

Metastelma arizonicum A. Gray

[*Cynanchum arizonicum* (A. Gray) Shinners. *Metastelma watsonianum* Standley]. Figure 50.

Small vines with many slender stems often twining together, often growing on small shrubs, or the stems sometimes vining on themselves and the plants forming small bushes. Plants glabrous except stems having with a longitudinal line of hairs between the nodes, the hairs short, white, and often recurved, and also with a similar line of hairs along the upper leaf midrib. Leaves 1.2–3 cm long, short-petioled, the blades narrowly oblong, dark green in winter, the margins becoming inrolled (revolute) especially in dry seasons. Flowers 4 mm long, in small axillary clusters, the petals (at least adaxially), corona, and gynostegium are all cream white. Inner surface of the corolla lobes densely hairy with white villous hairs. These hairs point downward towards the center of the flower—a small insect attracted to the flower would be directed towards the center of the flower, and the downward pointing hairs would prevent its access elsewhere. Fruits 4.5–6 cm long, elongated and smooth.

Arroyos, canyons, and rocky slopes; widespread in Arizona Upland regions of Organ Pipe, especially in the Ajo and Puerto Blanco Mountains.

Central Arizona to northern Sinaloa.

OP: Ajo Mts, "Sierra de Alamos," *Nichol 16 May 1937*. Dripping Springs, 18 Mar 1945, *Darrow 2436*. Bull Pasture Trail, 5 Nov 1977, *Bowers 947*. Walls Well Rd, *Van Devender 30 Aug 1978*. Upper North Alamo Canyon, 7 Mar 1987, *Van Devender 87-3*.

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